

## AS-i Safety Monitor

Version 3.10 with Muting functionality



SAFETY AT WORK



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## **1 General Information**

### **1.1 Explanation of symbols**

The symbols used in this operating manual are explained below.



**Attention!**

*Pay attention to passages marked with this symbol. Failure to observe the provided instructions could lead to personal injury or damage to equipment.*



**Notice!**

*This symbol indicates text which contains important information.*

### **1.2 Declaration of Conformity**

The AS-interface safety monitor has been developed and manufactured in accordance with the applicable European standards and directives.



**Notice!**

*The corresponding Declaration of Conformity and prototype test certificate can be found at the end of this operating manual.*

The manufacturer of the product possesses a certified quality assurance system in accordance with ISO 9001.

### 1.3 Standards

- Draft: Fundamentals for the testing and certification of "Bus systems for the transmission of safety-relevant messages"
- EN ISO 13849-1:2008/AC:2009
  - Safety of machines – safety-related elements of control systems - Part 1: General principles for design
- EN 50295:1999
  - Low-voltage switching devices; control-system and device interface systems; actuator sensor interface (AS-interface)
- EN 60204-1:2006 +A1:2009 (extracts)
  - Safety of machines – electrical equipment for machines – Part 1: general requirements
- EN 60947-5-1:2004/A1:2009
  - Low-voltage switchgear and controlgear - Part 5-1: control devices and switching elements; electromechanical control devices
- EN 61496-1:2008/A1:2008
  - Safety of machines - Non-contact safety guards - Part 1 General requirements and testing
- EN 61508-1:2010
  - Functional safety of electrical/electronic/programmable electronic safety-related systems - Parts 1-7
- EN 62061:2005/AC:2010
  - Safety of machines - Functional safety of electrical, electronic and programmable electronic safety-related control systems
- EN 50178:1997
  - Electronic equipment for use in power installations
- NFPA 79:2012 (excerpts)
  - Electrical standards for industrial machinery

## **1.4 Definition of terms**

### **Output switching element (safety output) of the AS-interface safety monitor**

Element activated by the logic of the monitor which is able to safely switch off the downstream control elements. The output switching element may switch to or remain in the ON state only when all components are functioning as intended.

### **Output circuit**

Consists of the two logically connected output switching elements.

### **OSSD**

The safe AS-interface components and functional components assigned to an output circuit. They are responsible for releasing the machine element which generates the hazardous movement.

### **Integrated slave**

Component in which sensor and/or actuator functions are grouped together with the slave to form a unit.

### **Configuration operation**

Operating state of the safety monitor in which the configuration is loaded and checked.

### **Master**

Component for data transmission that controls the logical and temporal behavior on the AS-interface line.

### **Muting**

Proper, application-intended, time-limited suppression of the protective field's safety function.

### **Muting restart**

Initiation of the override mode after a muting fault (flashing muting indicator).

### **Parallel muting (time-controlled muting)**

Muting is initiated if 2 defined muting sensor signals are activated within a defined time.

### **External device monitoring circuit (contactor monitoring)**

The external device monitoring circuit makes possible the monitoring of the switching function of the contactors connected to the AS-interface safety monitor.

### **Sequential muting (sequence-controlled muting)**

Muting is initiated if 4 muting sensor signals are sequentially activated in a defined order (muting sequence).



### **Safety output**

See output switching element.

### **Safe input slave**

Slave which reads in the safe ON or OFF state of the connected sensor or command device and transmits it to the master or safety monitor.

### **Safe output slave**

Slave to which the safety-oriented ON or OFF state is transferred by the safety monitor (released or disabled) and which controls a safe actuator for switching off or shutting down while under voltage.

### **Safe slave**

Slave for connecting safe sensors, actuators and other devices.

### **Safety monitor**

Component which monitors the safe slaves and the correct function of the network.

### **Slave**

Component for data transmission; the master cyclically addresses this component by its address. Only then does it generate an answer.

### **Standard slave**

Slave for connecting non-safe sensors, actuators and other devices.

### **Synchronization time**

The maximum permissible temporal offset between the occurrence of two events which are dependent on one another.

## **1.5 Abbreviations**

<b>AOPD</b>	Active Optoelectronic Protective Device
<b>AS-interface</b>	Actuator Sensor Interface
<b>AOPD</b>	Active Optoelectronic Protective Device
<b>CRC</b>	Cyclic Redundancy Check
<b>I/O</b>	Input/Output
<b>EDM</b>	External Device Monitoring
<b>EMC</b>	Electromagnetic compatibility
<b>ESD</b>	Electrostatic Discharge
<b>OSSD</b>	Output Signal Switching Device
<b>PELV</b>	Protective Extra-Low Voltage
<b>PFD</b>	Probability of Failure on Demand
<b>PLC</b>	Programmable Logic Control

## 1.6 Brief description

The actuator-sensor interface (AS-interface) has established itself as a system for networking primarily binary sensors and actuators at the lowest level of the automation hierarchy. The high number of installed systems, the ease of use and the reliable operating behavior also make the AS-interface interesting in the area of machine safety.

The **safe** AS-interface system is intended for safety applications up to Category 4 / PL e in accordance with ISO 13849-1. Mixed operation of standard components and safe components is possible.

The AS-interface safety monitor monitors within an AS-interface system the safe slaves which have been assigned according to the configuration specified by the user with the configuration software. Depending on the device model, up to two dependent or independent OSSDs, each with external device monitoring circuit, are available. In the event of a stop request or a defect, the AS-interface safety monitor safely switches off the system in protective operation mode with a maximum reaction time of 40 ms.

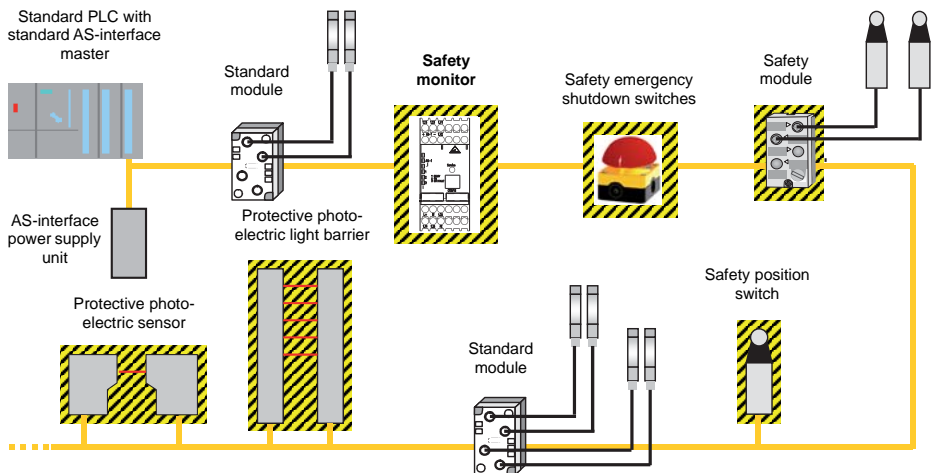


Figure 1.1: Safe and standard components in an AS-interface network

Multiple AS-interface safety monitors can be used within an AS-interface system. In this way, a safe slave can be monitored by multiple AS-interface safety monitors.

### System expansion - decentral, safe AS-interface output slaves

With the system expansion focused on the **safe connection of decentral, safe AS-interface output slaves** acc. to IEC 61508 SIL 3, additional device models with a **safe AS-interface output** are made available. These models (ASM2E/1 / ASM2E/2) are used in the following applications:

1. Safe integration and monitoring of AS-interface actuators or AS-interface actuator groups, e.g. for enabling motor starters or valve units through the safe AS-interface output of the safety monitor.

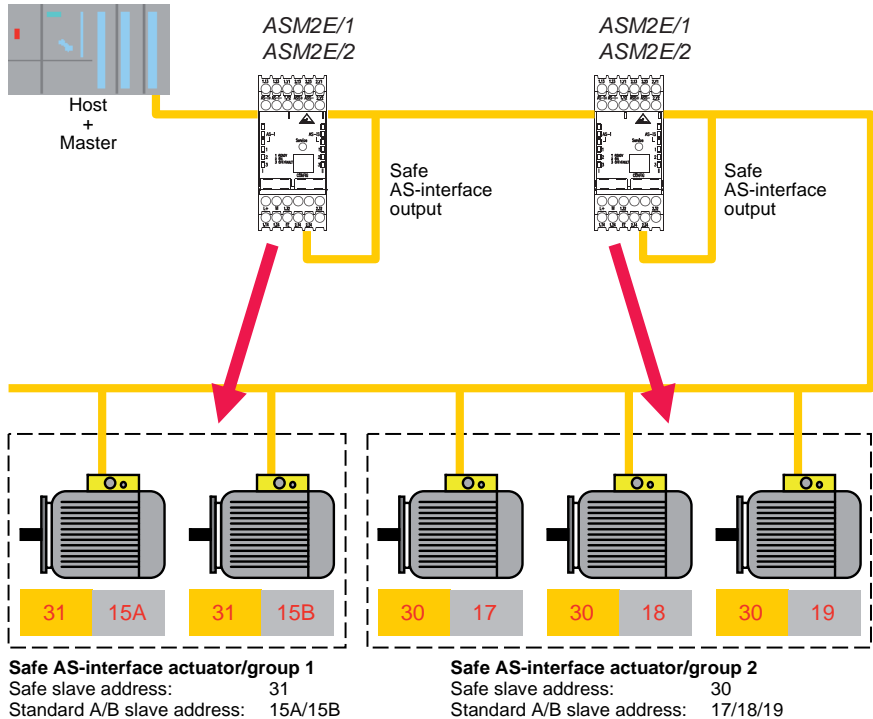


Figure 1.2: Example - Monitoring of 2 decentral AS-interface actuator groups



**Notice!**

*An AS-interface safety monitor can only monitor one actuator group.*

2. **Coupling of AS-interface networks** for the safe transmission of the state of an AS-interface safety monitor from one AS-interface network to another AS-interface network via the AS-interface using the function of the AS-interface safety monitor as a safe AS-interface input slave. This can be used, for example, for the creation of hierarchal networks for the realization of a system stop which functions across an AS-interface network or for the implementation of a system restart from one location.

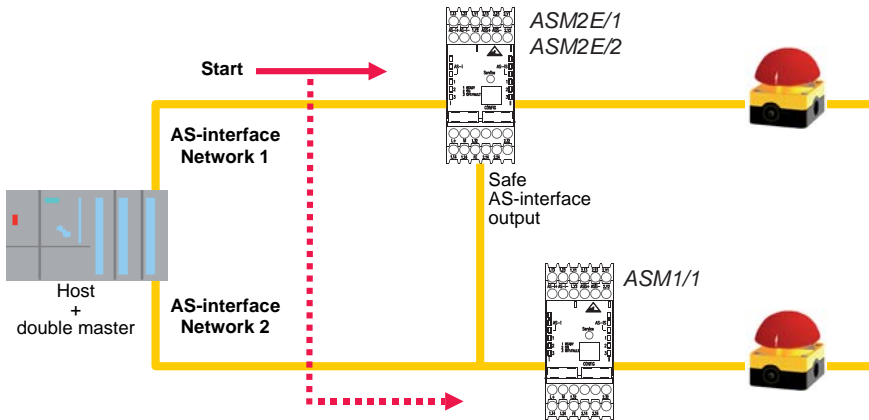


Figure 1.3: Example - Monitoring of 2 decentral AS-interface actuator groups

### ***System expansion - Muting via AS-interface***

The "Muting" function range of the AS-interface safety monitor offers the possibility of the proper, application-intended and time-limited bridging of the protective function of the Safety Light Curtain/ Multiple Light Beam Safety Device/Transceiver used for access guarding the danger zone by connecting 2 or 4 Muting sensors, e.g. if material is to be transported through the protective field into or out of the danger zone.

The integration of the muting function in the AS-i safety monitor offers a particularly economical and flexible automation solution: the peripheral sensor equipment required for muting evaluation of the system, consisting of muting and protective sensor, can be queried directly via AS-interface.

Depending on the number of required AS-interface addresses, multiple muting ranges can be configured and diagnosed on a system via a single AS-i safety monitor. The adjustable Muting modes can be changed at any time by means of the **asimon** configuration software.

## 1.7 Different types of AS-interface safety monitors

The AS-interface safety monitor has been further developed and expanded in functionality since the start of production in 2001.

The safety monitor is available in a total of 6 versions which differ with regard to the functions provided by the operating software and the initial configuration.



### **Notice!**

A detailed description of all of the functions for the AS-interface safety monitor device versions listed in the following can be found in the user manual supplied with the **asimon** configuration software.

### **Versions of the operating software, version 2.0**

The **"Basic"** and **"Enhanced"** function ranges differ as follows:

	<b>"Basic"</b>	<b>"Enhanced"</b>
Number of functional devices at logic level	32	48
OR gates (inputs)	2	6
AND gates (inputs)	no	6
Safe time function, switch-on and switch-off delay	no	yes
Function "button"	no	yes
Safety guard/module with debouncing	no	yes
Safety guard with lock	no	yes
Deactivation of functional devices	yes	yes
Reset of error condition	yes	yes
Diagnostics stop	yes	yes
Support of A/B technology for non-safe slaves	yes	yes
New functional devices (flip-flop, pulse on pos. edge, etc.)	no	yes
Dummy device (NOP)	no	yes

Table 1.1: "Basic" and "Enhanced" function ranges



### **Notice!**

Device versions of operating software 2.0 are backwards compatible with device versions of the first version of the operating software 1.1 with the **"Basic"** function range.

***New features beginning with Version 2.1 of the operating software***

zero sequence detection

door lock by means of delay time

door lock by means of zero-speed relay and delay time

activation via standard slave

activation via monitor input

operational switching by means of monitor input

double channel dependent with debouncing

double channel independent

**Output configuration**

ASM1/1      ASM1E/1

ASM1/2      ASM1E/2

**Features of device versions**

		Function range	
		"Basic"	"Enhanced"
Number of output circuits	1	ASM1/1	ASM1E/1
	2	ASM1/2	ASM1E/2

Features of device versions ASM1/1 ... ASM1E/2

***Notice!***

*Device versions of operating software 2.1 are backwards compatible with device versions of operating software 1.1 and 2.0.*



***New features beginning with Version 3.0 of the operating software***

In addition to the previous device types ASM1/1 ... ASM1E/2, also supported are **two new device types** of version 3 (ASM2E/1 and ASM2E/2) of the AS-interface safety monitor **with safe AS-i output**.

The following new features are included in version 3.0 of the operating software for the AS-interface safety monitor:

- Support of safe AS-i transmission for **controlling safe AS-interface actuators**
- **Coupling of multiple safe AS-interface networks** through the function of the safety monitor as a safe input slave (only for new device types with safe AS-interface output)
- Monitoring device **Double channel dependent with filtering**
- **Manual entry of the code sequences** for safe AS-interface slaves
- Availability of the **standard out bit of the master for the safe slaves and the slaves simulated by the safety monitor** for operational switching tasks (acknowledgments, enabling, unlocking, etc.)

**Output configuration**

Device types **ASM2E/1** and **ASM2E/2**:two separately switchable output circuits

**Features of device versions**

			Function range "Enhanced"	
			Output circuit 1	Output circuit 2
Number of output circuits	2	ASM2E/1	Relay	Safe AS-i output
		ASM2E/2	Relay	Relay + safe AS-i output

Table 1.3: Features of device versions ASM2E/1 and ASM2E/2



**Notice!**  
*Device versions of operating software 3.0 are backwards compatible with device versions of operating software 1.1, 2.0 and 2.1.*

### ***New features beginning with operating software version 3.08 Muting***

Beginning with Version 3.08 of the operating software for the AS-interface safety monitor, the "double channel dependent with debouncing" monitoring device is replaced within the device by the "double channel dependent with filtering" monitoring device.

In addition to the previous device types — ASM1E/1 ... ASM2E/2 with "Extended" function range — **4 new device types** of version 3 (ASM1E-m/1 ... ASM2E-m/2) of the AS-interface safety monitor **with Muting functionality** are also supported.

The following new features are included in version 3.08 of the operating software of the AS-interface safety monitor with muting functionality:

- Support of 2-sensor parallel muting
- Support of 4-sensor sequential muting
- Monitoring of multiple muting ranges (e.g. entry-exit applications of palleting systems)
- The following adjustment options in muting mode:
  - Monitorable time difference of the two muting sensors (2-sensor parallel muting only)
  - Direction control of the transport material (4-sensor sequential muting only)
  - Forward only
  - Direction change outside and inside of the muting range
  - Tight muting sequence (for areas of the conveyor system with very limited space)
  - Premature end of muting
  - Tolerated interruption time of the muting sensor signal (signal filter)
  - Monitorable muting timeout and interruption of the timeout by means of adjustable standard AS-interface information
  - Selectable muting enable by means of adjustable standard AS-i information

### **Features of device versions**

			Function range "Extended with muting"	
			Output circuit 1	Output circuit 2
Number of output circuits	1	ASM1E-m/1	Relay	—
		ASM2E-m/1	Relay	Safe AS-i output
	2	ASM1E-m/2	Relay	Relay
		ASM2E-m/2	Relay	Relay + safe AS-i output

Table 1.4: Features of device versions ASM1E-m/1 to ASM2E-m/2



#### ***Notice!***

*Device versions of operating software 3.08 with muting are downward compatible with device versions of operating software 1.1, 2.0, 2.1 and 3.0.*

### ***New features in software version 3.10 Muting***

The following new features are included in version 3.10 of the operating software for the AS-i safety monitor with muting:

- Diagnostics device for safety-oriented AS-i output slaves (actuator diagnostics)
  - Transmission of diagnostic information of the safety-oriented AS-i actuator through the AS-i safety monitor as a display in the asimon configuration software
  - Transmission of diagnostic information of the safety-oriented AS-i actuator via the AS-interface for evaluation in the superior control (PLC)
- External device monitoring circuit module External device monitoring circuit for safe output slave with Activate operational switching selection for the safety-oriented AS-interface actuator



#### ***Notice!***

*Device versions of operating software 3.10 with muting are backwards compatible with device versions of operating software 1.1, 2.0, 2.1 and 3.0x.*

## 2 Safety

Before the safety monitor is used, a risk evaluation acc. to valid standards must be performed (e.g. ISO 14121, EN ISO 12100-1, ISO 13849-1, IEC 61508, EN 62061). The result of the risk evaluation determines the necessary safety level of the safety monitor (see table in chapter 2.1.1). For mounting, operation and testing, document "AS-i safety monitor V 3.10 M" as well as all applicable national and international standards, guidelines, regulations and directives must be observed. Relevant documents included in delivery must be observed, printed and given to the affected staff.

Read the documents applicable to your tasks completely before starting work on the safety monitor and observe the information in them at all times.

The following national and international legal provisions in particular apply for start-up, technical tests and handling of safety sensors:

- Machinery directive 2006/42/EC
- Low voltage directive 2006/95/EC
- Electromagnetic compatibility 2004/108/EC
- Work equipment directive 89/655/EEC with supplement 95/63 EC
- OSHA 1910 sub-part O
- Safety regulations
- Accident-prevention regulations and safety rules
- Industrial safety regulation and employment protection act
- Equipment safety act



### **Notice!**

*Local agencies can also provide safety-relevant information (e.g. occupational safety and health inspectorate, employer's liability insurance association, labor inspectorate, OSHA).*

## 2.1 Proper use and foreseeable misuse



### **Warning!**

*Running machines can cause serious injuries!*

*Make sure that the system is securely shut down and protected against restarting during all retrofitting, maintenance work and tests.*

### 2.1.1 Proper use

- The safety monitor may only be used after it has been selected in accordance with the respective applicable manuals, the relevant regulations, standards and guidelines on industrial safety and safety at work and mounted, connected, started up and tested by a qualified person.
- When selecting the safety monitor, it must be ensured that its safety-relevant performance is equal to or higher than the necessary Performance Level PL<sub>r</sub> determined in the risk evaluation.

The following table displays the safety-relevant characteristics of the AS-i safety monitor.

Type in acc. with IEC/EN 61496-1	Type 4
SIL in acc. with IEC 61508	SIL 3
PFD <sup>1)</sup> in acc. with IEC 61508 for ASM1/1, ASM1/2, ASM1E/1, ASM1E/2, ASM1E-m/1, ASM1E-m/2	$6.1 \cdot 10^{-5}$
PFD <sup>1)</sup> in acc. with IEC 61508 for ASM2E/1, ASM2E/2, ASM2E-m/1, ASM2E-m/2	$7.2 \cdot 10^{-5}$
Average probability of a dangerous failure per hour (PFH <sub>d</sub> ) depending on the average annual number of switching cycles of the relays $n_{op}$ <sup>2) 3)</sup>	$n_{op} = 10,500: 9.1 \cdot 10^{-9} \text{ 1/h}$ $n_{op} = 28,000: 2.1 \cdot 10^{-8} \text{ 1/h}$ $n_{op} = 66,000: 5.0 \cdot 10^{-8} \text{ 1/h}$
Performance Level (PL) in acc. with ISO 13849-1: 2008	PL e
Category in acc. with ISO 13849-1: 2008	Cat. 4

- 1) The specified PFD values are based on a maximum request rate of the safety function of 1 time a year. In case of lower request rates, the switch-off of the safety monitor must be inspected in an annual test.

- 2)  $n_{op}$  = average number of annual actuations, see C.4.2 and C.4.3 of ISO 13849-1: 2009

Use the following formula when calculating the average annual number of actuations:

$$n_{op} = (d_{op} \cdot h_{op} \cdot 3600\text{s/h}) \div t_{Zyklus}$$

When doing so, assume the following is true concerning the use of the component:

$h_{op}$  = average number of hours of operation per day

$d_{op}$  = average number of days of operation per year

$t_{cycle}$  = average amount of time between the beginning of two subsequent cycles of the component (e.g. switching of a valve) in seconds per cycle

- 3) The specified PFH<sub>d</sub> values are based on 100% nominal load (contact load AC15/DC13). PFH<sub>d</sub> values for small nominal loads on request.

- The safety monitor monitors the mandatory emergency shutdown function for all non-hand-operated machines (Stop Category 0 or 1), the dynamic monitoring of the restart function and the contactor control.
- Settings and changes of the device configuration via PC and asimon configuration software must only be performed by an authorized safety officer.
- The password for changing a device configuration is to be held under lock and key by the safety officer.
- Combined with safety sensors, the safety monitor safeguards danger areas or points of operation.
- It must be possible to intervene in the control of the machine or system to be safeguarded by electrical means. A switch-off command initiated by a safety monitor must result in an immediate shutdown of the dangerous movement.
- The "Reset" acknowledgment button for unlocking the start-up/restart interlock must be mounted in

such a way that the entire danger area can be seen.

- The functional devices with start function in the asimon configuration and diagnostics software are used for assigning an automatic start-up, a start-up and/or restart interlock of the safety outputs of the AS-interface safety monitor. An active start-up/restart interlock can be released depending on the type of configuration by asimon through application of a reset button connected directly to the safety monitor or through the signal transmission of a start command via AS-interface. Use this function to monitor the start-up or restart of the safety monitor. When using a start function with automatic start-up through configuration using asimon, it must be ensured that no dangerous situation can arise during start-up of the machine/system or that a suitable start-up/restart interlock is implemented on another place or with other measures.
- Message outputs (state outputs) may not be used for switching safety-relevant signals.
- The safety monitor is designed for installation in a switch cabinet or protective housing with a protection class of at least IP 54.
- Depending on the external wiring, dangerous voltages can be present at the switching outputs. In addition to the power supply, these must be switched off and safeguarded against being switched back on prior to all work on the safety monitor.
- The operating instructions must be included with the documentation of the machine on which the protective device is installed so that they are available to the operator at all times.
- In the event of changes to the safety monitor, all warranty claims against the manufacturer of the safety monitor are voided.
- The safety monitor must be tested regularly by competent personnel.

- The safety distance between the AOPD and the point of operation is to be maintained. It is calculated according to the formulas for machine-specific C standards or given in the general B1 standard ISO 13855. Not only the reaction time of the AS-i safety monitor but also the braking time of the machine must be taken into account.
- 2 switching contacts are always to be looped into the switching circuit of the machine. To prevent wear and tear, relay switching contacts must be protected externally according to the technical data.
- The safety monitor must be exchanged after a maximum of 20 years. Repairs or exchange of wear parts do not lengthen the lifespan.
- The safety monitor corresponds to the requirements of safety category 4 in acc. with ISO 13849-1. If a safety sensor or a safety actuator of a lower safety category is connected, the overall category for the corresponding control path can not be higher than that of the connected safety sensor or safety actuator.
- The safety sensor must be disposed of accordingly. Observe the local regulations regarding disposal of the product.

### 2.1.2 Foreseeable misuse

Any use other than that defined under the "intended use" or which goes beyond that use is considered improper use!

E.g.

- Applications in explosive or easily flammable atmospheres
- Use on machines with long standstill times



#### **Warning!**

*Such instances can jeopardize the health and lives of the personnel operating the machinery and/or may cause damage to property.*

### 2.2 Qualified personnel

Prerequisites for competent personnel:

- Has completed an applicable technical training program.
- Knows the rules and guidelines on industrial safety, safety at work and safety technology and can assess machine safety.
- Is familiar with the instructions for the safety monitor and machine.
- Has been instructed by the responsible person on the mounting and operation of the machine and of the safety monitor.

## **2.3 Responsibility for safety**

Manufacturer and operating company must ensure that the machine and implemented safety monitor function properly and that all affected persons are adequately informed and trained.

The type and content of all imparted information must not lead to unsafe actions by users.

The manufacturer of the machine is responsible for:

- Safe construction of the machine
- Safe implementation of the safety monitor
- Imparting all relevant information to the operator
- Adhering to all regulations and directives for the safe commissioning of the machine
- The operator of the machine is responsible for:
- Instructing the operating personnel
- Maintaining the safe operation of the machine
- Adhering to all regulations and directives on industrial safety and safety at work
- Regular testing by competent personnel

## **2.4 Disclaimer**

Leuze electronic GmbH + Co. KG is not liable in the following cases:

- Safety monitor is not being used properly.
- Safety notices are not adhered to.
- Reasonably foreseeable misuse is not taken into account.
- Mounting and electrical connection are not properly performed.
- Proper function is not tested.
- Changes (e.g. constructional modifications) are made to the safety monitor.

### **2.4.1 Residual risks (EN ISO 12100-1)**

The wiring suggestions shown in this manual have been tested with utmost care. The relevant standards and regulations are adhered to if the shown components and appropriate wiring are used. Residual risks remain if:

- the suggested wiring concept is not adhered to and, as a result, the connected safety-relevant components or protective devices are not or are inadequately integrated into the safety circuit.
- relevant safety regulations specified for the operation, adjustment and maintenance of the machine are not adhered to by the operator. Here, the inspection and maintenance intervals for the machine should be strictly adhered to.



## **2.4.2 Areas of application**

Examples for the use of the AS-interface safety monitor:

The safety monitor is used commercially in machines and systems in which the standard AS-interface bus functions as the local bus. Thus, by using the safety monitor as a bus subscriber, existing AS-interface bus configurations can be expanded easily and safety elements with corresponding "AS-interface safety at work" interface easily integrated. If a safety component does not have an "AS-interface safety at work" interface, a so-called coupling module can be used to make the connection. Existing AS-interface master and AS-interface power supply units can continue to be used.

There are no branch-specific restrictions. Several of the primary areas of application are listed here:

- Machine tools
- Expanded machining machines with multiple control elements and safety sensors for wood and metal applications
- Printing and paper processing machines, cutting machines
- Packaging machines, single and as part of a system
- Food processing equipment
- Piece and bulk material transport systems
- Machinery in the rubber and plastics industry
- Assembly machines and manipulators

## **2.5 Additional safety notices for the "Muting" special function**

- Muting is the proper suppression of the safety function of an AOPD to e.g. allow a material flow through the protected field without creating a switching signal. Emergency shutdown command devices may not be muted.
- The protective function of this AOPD is overridden during the muting function! It must therefore be ensured in another way that, during the muting process, either access to the point of operation is impossible, e.g. because the material transport prevents access to the point of operation or, during the time of muting, no danger is present, e.g. during the return motion of a tool.
- The muting sensors must be arranged in such a way that manipulation with simple means is ruled out. As optical sensors, they can be attached high enough or far enough from one another that they cannot be covered by the operating personnel, or not at the same time. Concealed installation is recommended for switches.

## **2.5.1 Safety Notices for Muting applications**

### ***Muting when using optoelectronic protective sensors (AOPD)***

Vertically mounted optoelectronic protective sensors, such as Safety Light Curtains or Multiple Light Beam Safety Devices, are used primarily as access guards for danger zones. By means of additional sensor signals, the protective field effect can be suppressed for a limited time (Muting), e.g. during material transport in or out of the danger zone. The monitoring of Muting sensors and protective sensor is performed here by the AS-i Safety Monitor with Muting function range.

Safety Light Curtains with 14mm resolution detect a finger, hand, arm or body; those with 30mm resolution detect a hand, arm or body of a person who has entered the danger zone and can, thus, be mounted closer to the danger zone than Safety Light Curtains with 50mm or 90mm resolution or Multiple Light Beam Safety Devices or so-called Transceivers (transmitter-receiver systems in a device column integrated with Passive Deflecting Mirrors) that, due to their larger beam spacing, only detect the body of a person. Applicable for all version types is the fact that they only detect people during entry, not their presence in the danger zone! Upon interruption of a light beam or multiple light beams by a person, the control must, therefore, reliably lock.

For access guarding, the start-up/restart interlock function is, therefore, mandatory! Here, the start-/restart button for unlocking the start-up/restart interlock or Muting restart function must be located outside of the danger zone in such a way that it cannot be accessed from within the danger zone and so that the entire danger zone can be seen from its mounting location.

Before unlocking the start-up/restart interlock or the Muting restart, the operating person must have assured himself that no one is located within the danger zone.

The Muting sensors must be selected and arranged in such a way that they cannot be simultaneously and unintentionally activated by a single person.

Muting must only be activated temporarily and only as long as the access to the danger zone is blocked by the transport material. If the distance between transmitter and receiver or Transceiver and Passive Deflecting Mirror is greater than the width of the transport material, thereby enabling a person to enter the danger zone alongside the transport material during Muting, measures must be taken to detect entry and bring the dangerous movement to a standstill. PS mats or swing doors monitored with safety switches have been tried, tested and proven here. Such measures prevent injuries caused, for example, by crushing in the access area.

Muting must be automatic; it may not, however, be dependent on a single sensor signal, nor may it be fully dependent on software signals. Alternatively, a combination of sensor signal and independent software signal can be used.

The Muting function must be released immediately after the transport material has passed through, so that anybody passing through behind the transport material will be detected by the protective device.

Acc. to IEC 62046, initiating the bridging of a muting safety sensor (AOPD) may only be done a short distance in front of an object to be muted and this sensor must be deactivated again shortly after the object passes through. The gap which results from this (acc. to IEC 62046, max. 200 mm is permissible) may not be large enough for a person to pass the muted safety system in front of or behind the transport material.

If a signal triggered by a PLC is used as the muting signal (instead of a second built-in muting sensor), the following conditions apply:

1. The PLC muting signal may not be triggered by a person and
2. The PLC muting signal must be reset before the transport material has finished passing through.

The d5 distance measured between the optical axis of the AOPD and the intersection of the two light beams of the bridging sensors should be as small as is practical to prevent persons from entering the danger area undetected by directly following the pallet or the transport system. A distance  $d5 = 200 \text{ mm}$  is recommended.

The bridging sensors should be installed close enough to the AOPD so that a person who tries to enter the danger area by directly preceding or following the pallet or the transport system with  $<200 \text{ mm}$  is detected.

## ***Muting via AS-i with optoelectronic safety sensors (AOPD)***

Muting via AS-interface must only be triggered upon activation of 2 independent muting sensor signals or muting sensor signals and muting software signals if, depending on the safety category required for the machine or system acc. to ISO 13849-1, the integration of these muting signals satisfies:

## ***Integration of the muting sensor signals via AS-interface up to safety category 2 acc. to ISO 13849-1 (Performance Level max. PL d)***

### **• 2-sensor parallel muting (time controlled)**

Both Muting sensor signals (MS1, MS2) can be integrated together via a standard AS-interface input module (input slave) and transmitted for evaluation through the AS-interface safety monitor via AS-interface. Alternatively, one signal can be transmitted via a Muting sensor connected to a standard AS-interface input module and a second independent software signal can be transmitted directly by the control via the AS-interface master (AS-interface master output bit).

### **• 4-sensor sequential muting (sequence controlled)**

The muting sensor signals (MS1 ... MS4) can be integrated together via a standard AS-interface input module (input slave) and transmitted for evaluation through the AS-interface safety monitor via AS-interface. Alternatively, two signals (via MS2, MS3) can be transmitted via a standard AS-interface input module and two independent software signals (MS1, MS4) can be transmitted directly by the control via the AS-interface master (AS-interface master output bits).

***Integration of the muting sensor signals via AS-interface for safety category 3 and 4 acc. to ISO 13849-1 (Performance Level max. PL e)***

- **2-sensor parallel muting (time controlled)**

The Muting signals of the two required Muting sensors must be integrated by means of separate integration of the two Muting sensors via a standard AS-interface input module for each and transmitted via AS-interface for evaluation by the AS-interface safety monitor. Alternatively, one Muting sensor signal can be transmitted via a standard AS-interface input module and a second independent software signal can be transmitted directly by the control via the AS-interface master (AS-interface master output bit).

- **4-sensor sequential muting (sequence controlled)**

Each of the Muting sensor signals (MS1 ... MS4) must be integrated by means of separate integration of two Muting sensors via a standard AS-interface input module and transmitted via AS-interface for evaluation by the AS-interface safety monitor (MS1/MS3, MS2/MS4). Alternatively, two signals (MS2, MS3) can be transmitted via a standard AS-interface input module and two independent software signals (MS1, MS4) can be transmitted directly by the control via the AS-interface master (AS-interface master output bits).

### 3 Muting via AS-interface

#### 3.1 Optoelectronic Protective Devices for Muting applications

The protective device consists of a transmitter and a receiver or a transceiver with passive deflecting mirror. Beginning with the first beam (= synchronization beam) after the display field, the transmitter pulses beam for beam in rapid sequence. Synchronization between transmitter and receiver occurs optically.

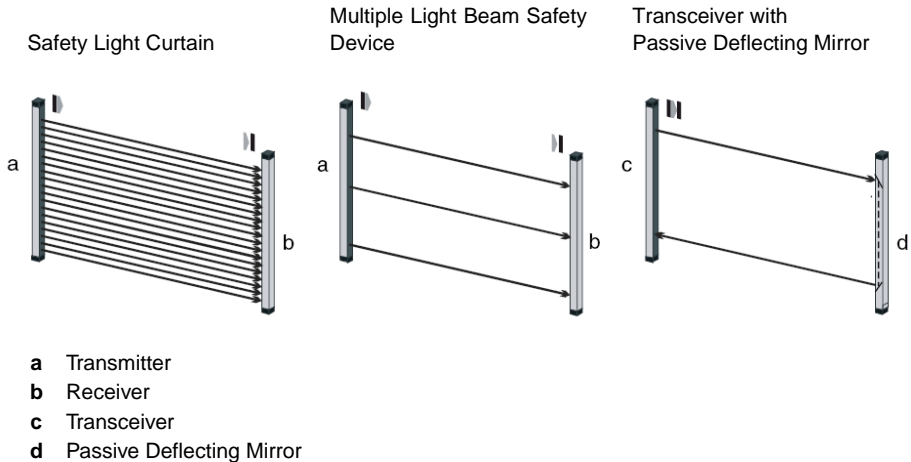


Figure 3.1: Variants of the Optoelectronic Protective Device for Muting applications

The receiver/transceiver detects the specially shaped pulse packets of the transmitted beams and opens the corresponding receiving elements in sequence in the same rhythm. In this way, a protective field is created in the area between the transmitter and receiver. The height of the area is determined by the geometric dimensions of the optical protective device; its width is determined by the distance selected between transmitter and receiver within the permissible operating range.



**Attention!**

*For the connection and start-up of Safety Light Curtains and Multiple Light Beam Safety Devices for Muting applications via AS-interface, knowledge of the technical description of the used protective sensor (e.g. Safety Light Curtain or Light Beam Safety Device) is necessary in addition to knowledge of the Connecting and Operating Instructions for the AS-interface safety monitor.*

## 3.2 Usage examples

### 3.2.1 4-sensor sequential muting (sequence-controlled muting)

4-sensor sequential muting with Multiple Light Beam Safety Device (up to safety category 2 acc. to ISO 13849-1), **PL d**.

#### **Used components:**

##### **Muting safety monitoring unit**

- AS-interface safety monitor ASM1E-m/1 with one output circuit and extended function range with Muting

##### **Protective sensor**

- Multiple Light Beam Safety Device, 3-beam, for access guarding, with integrated AS-interface for direct integration with the AS-interface network.

##### **Muting sensors MS1 ... MS4**

- 4 MS1 ... MS4 induction loops embedded in the floor. The induction loops are integrated in the AS-interface network via a standard AS-interface 4E-input module.

##### **Swing doors**

- 2 swing doors monitored by protective switches. Integrated in the AS-interface network via a safe AS-interface input module, they prevent the crushing of people between the conveyor and the support columns.

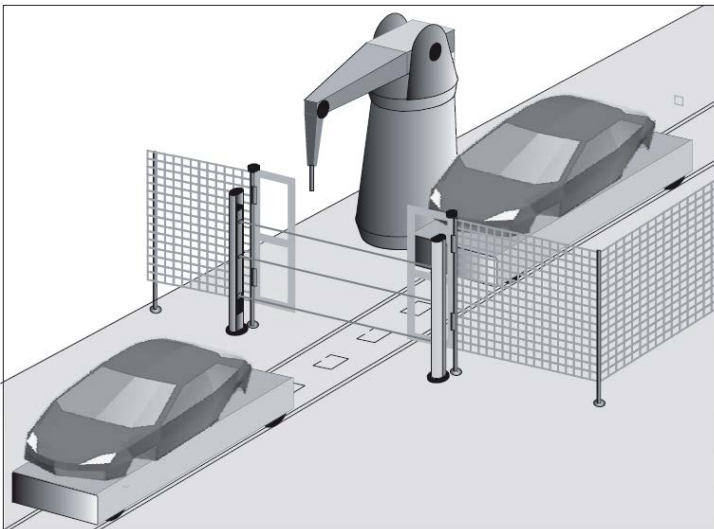


Figure 3.2: 4-sensor sequential muting application at a robot station

### 3.2.2 2-sensor parallel muting (time-controlled muting)

2-sensor parallel muting with transceiver system (up to safety category 4 acc. to ISO 13849-1, **PL e**)

#### *Used components:*

##### **Muting safety monitoring unit**

- AS-interface safety monitor ASM1E-m/1 with one output circuit and extended function range with Muting;

##### **Protective sensor**

- Multiple Light Beam Safety Device, 2-beam, implemented as transceiver, for access guarding, with integrated AS-interface.

##### **Muting sensors MS1 and MS4**

- AS-interface retro-reflective photoelectric sensors as Muting sensors MS1 and MS2 with reflectors. As a result, the AS-interface connections of the sensor system (safety and Muting sensor) are only necessary on one side. This connection technology saves costs in terms of material and time during start-up.

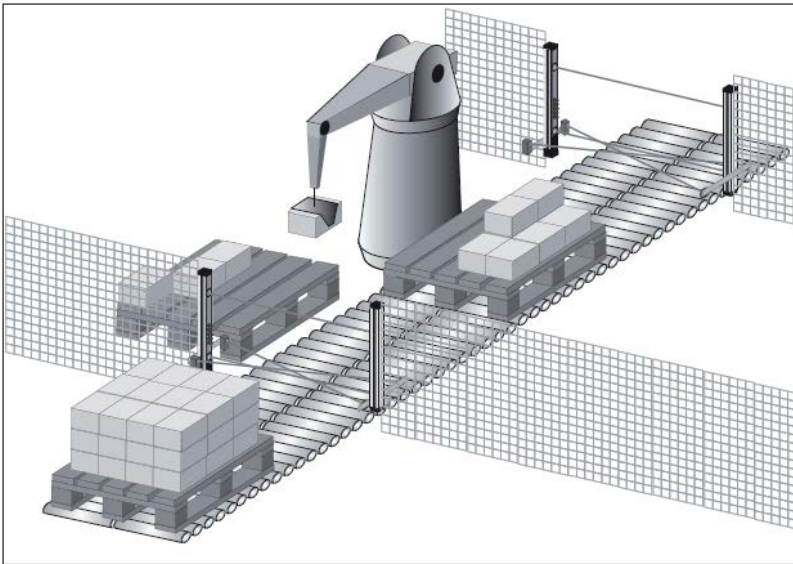


Figure 3.3: 2-sensor Parallel Muting application at a palletizer system

### 3.3 System design and Muting modes

#### 3.3.1 System design

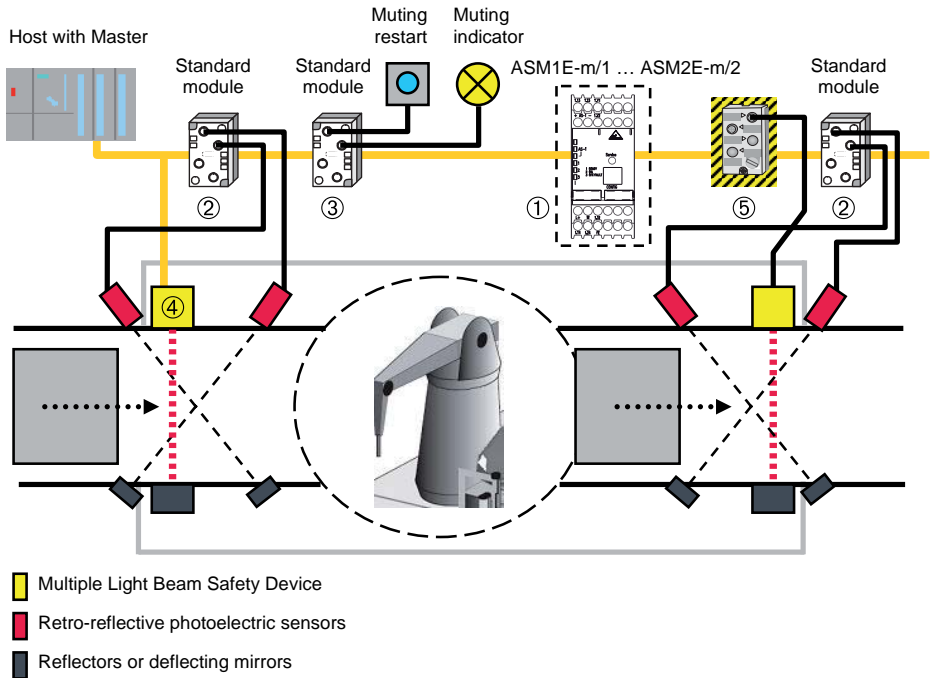


Figure 3.4: Principle system design for Muting via AS-interface, 2-sensor Parallel Muting

#### **Used system components:**

- AS-interface standard peripheral equipment (master device and AS-interface power supply unit).
- AS-interface safety monitor with muting function range ( ① ).
- Standard AS-interface input modules for connecting the muting sensors (e.g. retro-reflective photoelectric sensors) ( ② ).
- Standard AS-interface input module for connecting a button for the muting start function (or for override mode) ( ③ ) or
- Safe AS-interface input module for connecting a key switch for the safe Muting start function.
- Standard AS-interface output module for connecting a Muting indicator for signaling the running Muting process.
- Multiple Light Beam Safety Device (e.g. 2-beam for body detection) with integrated AS-interface interface ( ④ ) for direct connection to AS-interface or for connecting the sensor via a safe AS-interface input module ( ⑤ ).



## Muting modes

Via the **asimon** configuration software, the Muting type is selected and the available Muting parameters set.

2-sensor parallel muting	Adjustable
4-sensor sequential muting	One direction
	Direction change within muting range
	Direction change outside of muting range
	Tight Muting sequence (at least 1 sensor between 2 muting objects must be free)
Muting timeout	With permitted interruption
	Without interruption
Muting Enable	Not used
	Dynamic
End of Muting	Premature end of Muting determined by protective sensor (AOPD)
	Muting end determined by the Muting sensor
Extension of the Muting time	Adjustable



### Notice!

Details on the Muting parameters can be found in the User's Guide for the **asimon** configuration and diagnostics software.

## Muting sensors

Muting is initiated by the Muting sensor signals. Examples of Muting sensors that may be used include:

- Light Beam Devices (transmitter/receiver or retro-reflective photoelectric sensors) whose beam paths intersect behind the protective field within the danger zone.
- Light scanners that scan along the side of the transport material.
- Light Beam Device(s) and an acknowledgment signal from the conveyor drive or a PLC signal, provided both signals are activated within the simultaneity or sequence conditions set with **asimon**.
- Switching signals from induction loops that are activated e.g. by a high-lift truck.



**Notice!**

Please note that, depending on the degree of expansion of the network, the filter time in the AS-interface safety monitor may be as large as 25ms (full expansion of the network) for standard AS-interface signal inputs and AS-interface masterbit signals (AS-interface signal outputs). Thus, this also applies for muting sensor signals whose brief signal lapses  $\leq 25\text{ms}$  are not relevant for muting processing in the AS-interface safety monitor (for full expansion).



**Attention!**

In any case, the Muting sensors must be arranged in such a way that a person cannot be in a position to activate the Muting function through simple manipulation.

### 3.3.2 4-sensor sequential muting

4-sensor sequential muting requires the connection of 4 muting sensors and their activation in a specified sequence. It is used primarily if the transport material or the transport equipment always has the same dimensions and there is sufficient space for entry and exit. Sequential muting is initiated after activation of the second muting sensor both in the **MS1 → MS2 → MS3 → MS4** sequence as well as in the **MS4 → MS3 → MS2 → MS1** sequence (in setting: **Direction change outside of muting range**).

Brief lapses in muting sensor signals with a duration of 0 ... 2s are permissible. The permitted sensor-signal interruption time can be set via **asimon**.



**Attention!**

↪ When calculating the safety distance to be upheld between the muting safety sensor and the point of operation, add both the sensor signal interruption time set via **asimon** and the general filter time for AS-i I/O signals (in full system expansion of the AS-i network  $\leq 25\text{ms}$ ) to the system reaction time from the AS-i safety monitor and safety sensor (see chapter "System reaction times – example calculations").



**Attention!**

Depending on the speed of the conveyor, the sum of the set sensor signal interruption time and the set muting extension time must not be greater than the muting process time required by the object upon exit from the muting range.



**Notice!**

The advantage of sequential muting over parallel muting is that only the order of sensor activation/deactivation is detected. The time difference between the sensor signals plays no role here.



## Notice!

To apply the muting from the input area to the output area of the muting path, all 4 sensors must be briefly activated simultaneously. The transport material that is to be "muted" must, thus, be sufficiently long.

4-sensor sequential muting is ended correctly, i.e. the output switching elements of the AS-interface safety monitor (OSSDs) remain in the ON state during passage if, during the expected sequence, the third activated muting sensor becomes free and, as a result, switches to inactive for a period of time exceeding the sensor interruption time permitted by the configuration.

4-sensor sequential muting is ended incorrectly, i.e. the output switching elements (OSSDs) of the AS-interface safety monitor switch off, if

- a muting sensor switches incorrectly during the muting process.
- the length of the object is shorter than the distance between muting sensor 1 and muting sensor 4.
- the movement direction changes within the muting path, unless setting **Direction change within muting range** is selected in the configuration.
- during muting, a second object enters the muting path, unless the setting **Tight muting sequence** is selected in the configuration.
- the set muting time limit (muting timeout) has elapsed.

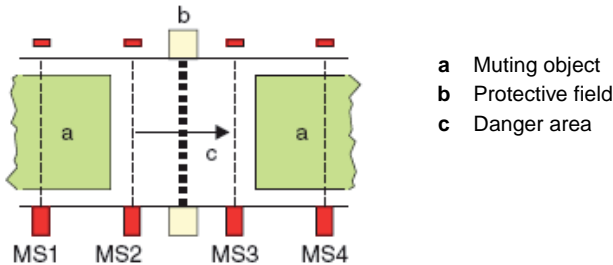


Figure 3.5: System arrangement for 4-sensor sequential muting

**Time diagram**

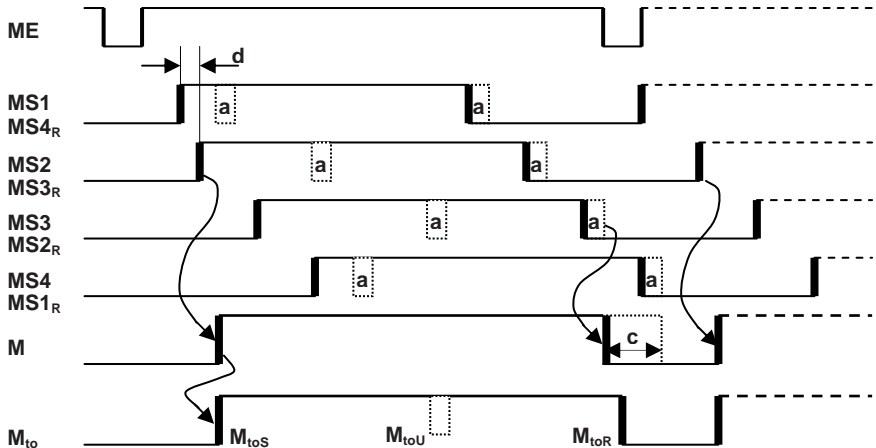


Figure 3.6: Time diagram: 4-sensor sequential muting

- ME** Muting **Enable dynamic**.  
One signal interruption caused by the Muting function block is expected during each Muting cycle.
- MS#** Muting sensor no. #, forward travel.
- MS#<sub>R</sub>** Muting sensor no. #, backward travel.
- M** Muting.  
Muting is active if the correct sequence MS1 → MS2 → MS3 → MS4 or MS4<sub>R</sub> → MS3<sub>R</sub> → MS2<sub>R</sub> → MS1<sub>R</sub> is maintained and at least 2 Muting sensors are active simultaneously.
- a** Suppression of brief signal interruptions of the Muting sensors (**Tolerated interruption time**; configurable).
- c** Muting time extension (**Extension time**; configurable).  
Muting ends after MS3 or MS2<sub>R</sub> is inactive for longer than the permitted signal interruption time and the Muting extension time **c** has elapsed.
- d** The time difference between the activation of 2 Muting sensors must be at least 2 AS-interface cycles.
- M<sub>toS</sub>** Start Muting timeout (Muting time limiting).  
The Muting timeout control monitors the adherence of the time required for a Muting event (**Monitoring time** Muting cycle; configurable).
- M<sub>toR</sub>** Reset of the Muting-timeout monitoring time.
- M<sub>toU</sub>** Muting-timeout interruption.  
By means of a PLC signal (AS-interface masterbit; configurable), the timeout monitoring time can be interrupted and reactivated upon removal of the PLC signal.

### 3.3.3 2-sensor parallel muting

2-sensor Parallel Muting requires the connection of 2 Muting sensors and the activation of each within a specified period of time. If both Muting sensors, MS1 and MS2, are switched within 2.5s (factory setting, time can be adjusted via **asimon**), 2-sensor Parallel Muting is initiated.

This type of muting is frequently used if the dimensions of the transport material are not constant in the transport direction and/or there is insufficient space in front of the protective device.



#### **Attention!**

*It is important that the intersection point of the two muting sensor light beams lies behind the optical protective device, i.e. within the danger zone!*



#### **Notice!**

*Due to signal testing by the AS-i safety monitor, exact simultaneity (time difference  $\leq 15\text{ms}$ ) of the two muting sensor signals must be avoided if*

- 2 muting sensors are directly connected on a standard AS-i input module (or input slave). This applies when, in the muting functional device configured via **asimon**, only 1 AS-interface slave is selected and 2 IN bits are chosen in doing so (see chap. 4.3.3 "Muting functional devices" of the software manual).



#### **Attention!**

When calculating the safety distance to be upheld between the muting safety sensor and the point of operation, add both the sensor signal interruption time set via **asimon** and the general filter time for AS-i I/O signals (in full system expansion of the AS-i network  $\leq 25\text{ ms}$ ) to the system reaction time from the AS-i safety monitor and safety sensor (see chapter "System reaction times – example calculations").

Advantages of 2-sensor parallel muting are:

- low expense, as only 2 muting sensors are required.
- the possibility to move forward and backward within the muting path.

Once Muting has been initiated, one of the two sensor signals may be briefly interrupted for a period of time not exceeding 100ms (factory setting). 2-sensor parallel muting is ended correctly if one of the muting sensor signals becomes inactive after the protective sensor becomes free.

The output switching elements (OSSDs) of the AS-interface safety monitor remain in the ON state during muting, i.e. as the transport material passes through.

2-sensor parallel muting is ended incorrectly, i.e. the output switching elements (OSSDs) of the AS-interface safety monitor switch OFF, if

- a Muting signal is inactive during the passage of the transport material for a period of time exceeding 100ms (factory setting).
- the muting-timeout monitoring time has elapsed.

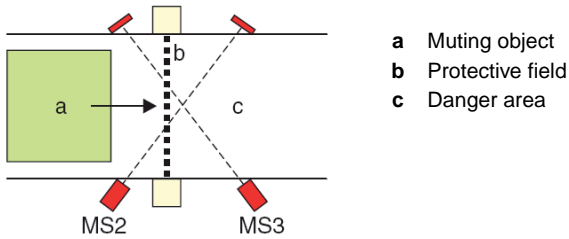


Figure 3.7: System arrangement for 2-sensor Parallel Muting

### Time diagram

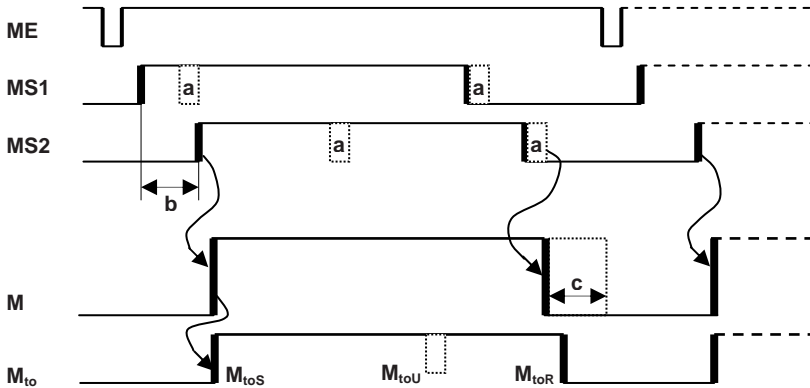


Figure 3.8: Time diagram: 2-sensor Parallel Muting

#### **ME** Muting **Enable dynamic**.

One signal interruption caused by the Muting function block is expected during each Muting cycle.

#### **MS** Muting sensor no.

#### **M** Muting.

Muting is active if both Muting sensors, MS1 and MS2, are activated within time period **b** and remain active during the entire Muting cycle.

#### **a** Suppression of brief signal interruptions of the Muting sensors (**Tolerated interruption time**; configurable)

#### **b** Muting-sensor simultaneity monitoring.

Configurable time period within which both Muting sensors, MS1 and MS2, must be activated in order to initiate Muting.

- c** Muting time extension (**Extension time**; configurable).  
Muting ends when at least one Muting sensor is inactive for longer than the permissible signal interruption time and the Muting extension time **c** has elapsed.
- M<sub>toS</sub>** Start Muting timeout (Muting time limiting).  
The Muting timeout control monitors the adherence of the time required for a Muting event (**Monitoring time** Muting cycle; configurable).
- M<sub>toR</sub>** Reset of the Muting-timeout monitoring time
- M<sub>toU</sub>** Muting-timeout interruption.  
By means of a PLC signal (AS-interface masterbit; configurable), the timeout monitoring time can be interrupted and reactivated upon removal of the PLC signal.

### 3.3.4 Muting time limit – Muting timeout

If the muting function is activated for longer than the configured monitoring time (150s factory setting), this is detected as a muting error and is ended by the AS-interface safety monitor independent of the selected muting mode.

A new muting event is not started until a valid muting sequence is initiated. The muting time limit is mandatory. During machine pause times, the Muting time limit can be paused (setting **Timeout interruption** via **asimon**) in order to prevent the AS-interface safety monitor from switching to the Muting error state after the Muting time limit elapses and allow the system to be restarted normally.



#### **Attention!**

*The user accepts responsibility for switching off muting time monitoring!*



#### **Notice!**

*Muting time monitoring can only be paused while muting is active (dynamic signal).*

### 3.3.5 Muting restart - Override mode

Operating conditions may require a valid Muting sequence to be interrupted, resulting in the Muting event being terminated by the AS-interface safety monitor. To prevent the object (transport material) from being manually removed from the Muting path, the Muting function range of the AS-interface safety monitor offers an integrated override mode that allows the transport material to be moved out of the Muting path. Such interruptions occur e.g.

- in the event of failure of the supply voltage while a permissible object passes through the Muting path. Upon return of the supply voltage, the Muting event does not continue automatically, since the expected Muting sequence is not supplied by the already activated Muting sensors.
- if, prior to activation of the second Muting sensor required for Muting due to unfavorable loading of the pallet to be transported, the protective field has already been violated and Muting cannot, thus, become active.

In override mode, the output switching elements (OSSDs) of the AS-i safety monitor are or remain switched on

- if at least one muting sensor is activated or
- for the set muting end extension time or
- for the tolerated muting sensor interruption time

and

- the muting start/restart button is actuated once.

In this case, the muting restart button must be pressed for min. 200ms and max. 2s.

**Notice!**

*To start the system with free safety sensor, the muting start button must be actuated once. In this case, the muting restart button must be pressed for min. 200ms and max. 2s.*

To (re-) start the system with free safety sensor, the muting restart button must be actuated once. In this case, the muting restart button must be pressed for min. 200ms and max. 2s.

**Notice!**

*After the muting sequence is ended three times in a row by overriding the object with the muting restart button, it is not possible to override the object again. The AS-interface safety monitor enters the error state.*

**Attention!**

*The error must be remedied e.g. on one of the built-in muting sensors or on the muting safety sensor!*

↩ Remedy the error state by either switching the AS-interface safety monitor off and on or by actuating the muting restart button twice.

During the second actuation, the button must be held down until a valid muting combination (muting sequence) is detected by the AS-i safety monitor. This enables obligatory driving out of the transport material from the muting area in the event of defective muting system components, for instance. In this case, the start button must be pressed for min. 200ms and max. 2s. Between the two actuations, a pause of min. 200ms and max. 2.5s must be allowed to pass.

Upon the second release of the muting restart button or the key switch, the AS-interface safety monitor checks the muting sensors for a valid assignment. If a valid muting combination is found to exist (e.g. during 4-sensor sequential muting: MS3 follows MS2), the output switching elements (OSSDs) remain in the ON state; the system resumes normal operation;

If, on the other hand, an invalid muting combination is ascertained when the protective sensor is bridged, the output switching elements (OSSDs) of the AS-interface safety monitor remain enabled only as long as the button is pressed. If it is released, the system stops again. This occurs, for example, with misadjusted, soiled or damaged muting sensors or with improperly loaded pallets.



**Attention!**

*Override must only be performed if the entire danger zone can be viewed during this process. This means it must be ensured that the entire danger zone can be viewed from the mounting location of the muting start/restart button. The error must be examined by a competent person.*

### 3.3.6 Muting status

Acc. to IEC EN 61496-1 and IEC 62046, the muting process must be displayed. This can occur

- through transmission of a Muting status signal to the PLC for further user-specific evaluation or
- through direct display via a connected indicator.



**Notice!**

*It is recommended that a highly visible Muting indicator be installed directly on-site near the Muting application.*

This can be used to signal the two following pieces of information to the operating personnel:

- When constantly illuminated, the indicator signals that Muting has been correctly initiated and the protective function is bridged at the AS-interface safety monitor during the Muting time.
- When flashing, the indicator signals that a Muting error has occurred (e.g. the Muting time limit has been exceeded)

#### ***Controlling an indicator for signaling the Muting status via AS-interface***

The indicator can be integrated directly into the AS-interface network via a standard AS-interface input slave or via an integrated AS-interface interface and cyclically controlled by the PLC and AS-interface master call. The Muting diagnostic information for the PLC is transmitted cyclically by the AS-interface safety monitor via the AS-interface master.



**Notice!**

*Detailed information on evaluating the **diagnostic data** made available by the AS-interface safety monitor via AS-interface with extension for the Muting function range can be found in chapter 13.*

### 3.4 Mounting the Muting system components

In this chapter you will find important information on mounting the system components necessary for the Muting function range of the AS-interface safety monitor (consisting primarily of Muting sensors and Safety Light Curtains or Multiple Light Beam Safety Devices) and whose protective function is only ensured if the following installation guidelines are adhered to.

These installation specifications are based on the respective applicable versions of European standards, such as EN 999, ISO 13855 and EN ISO 13857.

**Attention!**

*When used in countries outside of Europe, the guidelines applicable in the respective country are to be observed as well.*

#### **Minimum distances and positions of the components**

Optical protective devices can only fulfill their protective function if they are mounted with sufficient safety distance.

The calculation formulas for the safety distances are dependent on the type of safeguarding. In harmonized European standard EN 999, "The positioning of protective equipment in respect of approach speeds of parts of the human body", installation situations and calculation formulas for the safety distance for the aforementioned types of safeguarding are described.

The formulas for the necessary distance to reflecting surfaces are based on European standard prEN EC 61496-2 for "Active opto-electronic protective devices" (AOPD).

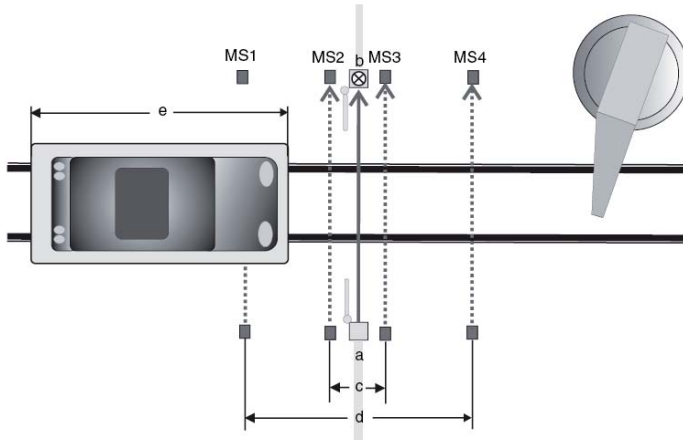
**Attention!**

*Safety notice! For the selection of the components and the calculation of the safety distances for Safety Light Curtains or Multiple Light Beam Safety Devices, knowledge of the technical description is necessary.*

**Attention!**

*The following applies for all Muting types: it must not be possible to simultaneously activate two Muting sensors, e.g. with a shoe (see figure 3.10)!*

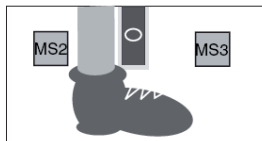
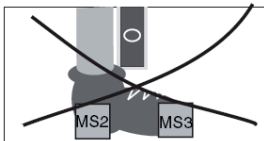
**Sensor positions for 4-sensor Sequential Muting**



- a Transmitter
- b Receiver
- c Distance between MS2 and MS3 symmetric to the protective field. **Attention!** It must not be possible to simultaneously trigger MS2 and MS3, e.g. with a shoe (figure 3.10)
- d Distance between MS1 and MS4 symmetric to the protective field:
- e as large as possible, but smaller than **e** to ensure that all sensors are occupied before the first sensor that was activated is again released.
- e Constant length of transport vehicle

Figure 3.9: Arrangement of the Muting sensors, 4-sensor Sequential Muting

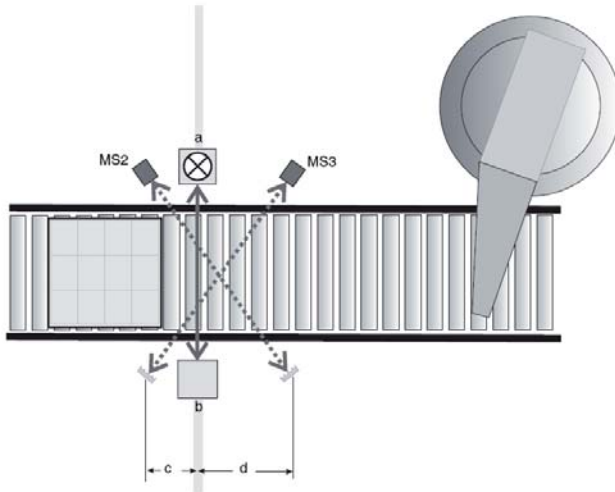
The example shows four dark-switching throughbeam photoelectric sensors as Muting sensors whose receivers switch active high when occupied, this means that they supply +24V to the assigned Muting inputs of the standard AS-interface input slave. Inductive buttons or switches can also be used. If there is a risk of crushing between the transport vehicle and the protective device, it is recommend that swing doors, for example, with a width of approx. 500mm and monitored by circuit breaker, be integrated as standard equipment in the release circuit of the AS-interface safety monitor independent of the Muting functional device.



**Attention!**  
The following applies for all Muting types: it must not be possible to simultaneously activate two Muting sensors, e.g. with a shoe!

Figure 3.10: Arrangement of Muting sensors MS2 and MS3

## Sensor positions for 2-sensor Parallel Muting



- a** Transceiver
- b** Passive Deflecting Mirror
- d > c** Asymmetric arrangement, so that the intersection point of the beam path of Muting sensors MS2 and MS3 lies within the danger zone.

Figure 3.11: Arrangement of the Muting sensors, 2-sensor Parallel Muting

By positioning the beam-path intersection point of the Muting sensors within the danger zone, a person entering the area would first interrupt the protective field and then simultaneously interrupt both light beams of the Muting sensors.

In the example above, two dark-switching retro-reflective photoelectric sensors send +24V to the assigned Muting inputs of the standard AS-interface input slave upon interruption.



### Attention!

**The following applies for all Muting types: it must not be possible to simultaneously activate two Muting sensors, e.g. with a shoe (see figure 3.10)!**



### Notice!

**If possible at the installation site, MS2 and MS3 should be mounted at different heights in such a way that the intersection of the beam paths is not point-shaped.**

## 4 Specifications

### 4.1 General technical data

#### Electrical data

Operating voltage $U_b$	24 V DC +/- 15%	
Residual ripple	< 15%	
Rated operating current	ASM1/1, ASM1E/1 and ASM1E-m/1: ASM1/2, ASM1E/2, ASM2E/1, ASM2E-m/1 and ASM1E-m/2: ASM2E/2 and ASM2E-m/2:	150 mA  200 mA 250 mA
Peak switch-on current <sup>1)</sup>	All types: 600 mA	
Reaction time <sup>2)</sup> (safety-relevant)	< 40 ms	
Delay before start-up	< 10 s	

1) Simultaneous switch-on of all relays; the current for the message outputs is not taken into consideration

2) Attention! Please observe the notices for calculating the reaction times in chapter 4.2.




#### AS-interface data

AS-interface profile	Monitor 7.F
AS-interface voltage range	18.5 ... 31.6 V
AS-interface current consumption	< 45 mA
Number of devices per AS-interface branch	In a fully configured AS-interface network with 31 used standard addresses, it is possible to additionally install a maximum of four safety monitors without address. If fewer than 31 standard addresses are used, an additional monitor can be installed for each standard address that is not used. If additional subscribers are installed without address (e.g. earth-fault monitoring modules), the number of installable safety monitors is reduced accordingly. If repeaters are used, this applies for each segment.

#### Mechanical data

Dimensions (WxHxD)	45 mm x 105 mm x 120 mm
Housing material	Polyamide PA 66
Weight	ASM1/1, ASM1E/1 and ASM1E-m/1: approx. 350 g ASM2E/1 and ASM2E-m/1: approx. 420 g ASM1/2, ASM1E/2, ASM2E/2, ASM1E-m/2 and ASM2E-m/2: approx. 450 g
Mounting	Snap-on mounting on top-hat rail acc. to EN 50022

Connection

 Ø 5 ... 6 mm / PZ2	0,8 ... 1,2 Nm 7 ... 10.3 LB.IN
	1 x (0,5 ... 4,0) mm <sup>2</sup> 2 x (0,5 ... 2,5) mm <sup>2</sup>
	1 x (0,5 ... 2,5) mm <sup>2</sup> 2 x (0,5 ... 1,5) mm <sup>2</sup>
<b>AWG</b>	2 x 20 ... 14

## Configuration interface

RS 232 9600 baud, no parity, 1 start bit, 1 stop bit, 8 data bits

## Inputs and outputs

"Start" input	Optical coupling input (high active), input current approx. 10mA at 24V DC
"External device monitoring circuit" input	Optical coupling input (high active), input current approx. 10mA at 24V DC
Message output "safety on" <sup>1)</sup>	PNP transistor output, 200mA, short-circuit and polarity-reversal protection
Safety output	Potential-free make contact, max. contact load: 1 A DC-13 at 24V DC 3 A AC-15 at 230V AC
Continuous thermal current (max.)	<u>ASM1/1, ASM1E/1, ASM2E/1, ASM1E-m/1 and ASM2E-m/1:</u> max. total current for all output switching elements: 6 A i.e. output circuit 1: 3 A per output switching element <u>ASM1/2, ASM1E/2, ASM2E/2, ASM1E-m/2 and ASM2E-m/2:</u> max. total current for all output switching elements: 8 A i.e. output circuit 1: 3 A per output switching element output circuit 2: 1 A per output switching element or output circuit 1: 2 A per output switching element output circuit 2: 2 A per output switching element
B10 value with ohmic load acc. to EN 61810-2	At max. contact load: $2 \cdot 10^5$ At $\frac{1}{4}$ max. contact load: $4 \cdot 10^5$ At $\frac{1}{10}$ max. contact load: $2.5 \cdot 10^6$
Safeguarding	External with max. 4 A slow blow
Overvoltage category	3, for rated operating voltage 300V AC acc. to VDE 0110 part 1

1) The "Safety on" message output is not relevant to safety!

## Environmental data

Operating temperature	-20 ... +60°C
Storage temperature	-30 ... +70°C
Protection class	IP 20 (only suitable for use in electrical operating rooms / switching cabinets with minimum protection class IP 54)



### Attention!

*The AS-interface power supply unit for supplying the AS-interface components must demonstrate safe mains separation acc. to IEC 60742 (PELV) and the ability to bridge short-term mains failures of up to 20ms.*

*The power supply unit for 24V supply must also demonstrate safe mains separation acc. to IEC 60742 (PELV) and the ability to bridge short-term mains failures of up to 20ms.*



**Notice!**

*The safety monitor has been tested for interference-free operation acc. to EN 61000-4-2 with 8kV air discharging. The air discharging value of 15 kV stipulated by EN 61496-1 is not relevant for the safety monitor as the safety monitor is installed in a system which is contained either in a protective housing or a switching cabinet and the monitor can be accessed only by trained personnel. Nevertheless, we recommend that before the user inserts the configuration cable into the safety monitor he perform a discharge (earthing) at a suitable location.*

## 4.2 Safety-relevant characteristic data

Characteristic data, standard	Value
Type in acc. with IEC/EN 61496-1	Type 4
SIL in acc. with IEC 61508	SIL 3
Maximum switch-on time in months in acc. with IEC 61508	12
PFD <sup>1)</sup> in acc. with IEC 61508 for ASM1/1, ASM1/2, ASM1E/1, ASM1E/2, ASM1E-m/1, ASM1E-m/2	$6.1 \cdot 10^{-5}$
PFD <sup>1)</sup> in acc. with IEC 61508 for ASM2E/1, ASM2E/2, ASM2E-m/1, ASM2E-m/2	$7.2 \cdot 10^{-5}$
Average probability of a dangerous failure per hour (PFH <sub>d</sub> ) depending on the average annual number of switching cycles of the relays $n_{op}$ <sup>2) 4)</sup>	$n_{op} = 10,500: \quad 9.1 \cdot 10^{-9} \text{ 1/h}$ $n_{op} = 28,000: \quad 2.1 \cdot 10^{-8} \text{ 1/h}$ $n_{op} = 66,000: \quad 5.0 \cdot 10^{-8} \text{ 1/h}$
Number of cycles until 10% of the components have failed dangerously (B10 <sub>d</sub> )	400,000 switching cycles at nominal load 1 m switching cycles at 80% of the nominal load 2.5 m switching cycles at 60% of the nominal load 7.5 m switching cycles at 40% of the nominal load 20 m switching cycles at 20% of the nominal load
Max. system reaction time <sup>3)</sup> in milliseconds	40
Performance Level (PL) in acc. with ISO 13849-1: 2008	PL e
Category in acc. with ISO 13849-1: 2008	Cat. 4

- 1) The specified PFD values are based on a maximum request rate of the safety function of 1 time a year. In case of lower request rates, the switch-off of the safety monitor must be inspected in an annual test.
- 2)  $n_{op}$  = average number of annual actuations, see C.4.2 and C.4.3 of ISO 13849-1: 2009

Use the following formula when calculating the average annual number of actuations:

$$n_{op} = (d_{op} \cdot h_{op} \cdot 3600s/h) \div t_{Zyklus}$$

When doing so, assume the following is true concerning the use of the component:

$h_{op}$  = average number of hours of operation per day

$d_{op}$  = average number of days of operation per year

$t_{cycle}$  = average amount of time between the beginning of two subsequent cycles of the component (e.g. switching of a valve) in seconds per cycle

- 3) About the system reaction time:

**Attention!**  
In addition to the system reaction time of max. 40ms, the reaction times of the safe AS-i sensor slave, of the sensor being used for monitoring, of the safe AS-i actuator slave and of the actuator used for this purpose must still be added.  
Please note that additional reaction times may likewise arise through the configuration of the safety monitor.

- 4) The specified PFH<sub>d</sub> values are based on 100% nominal load (contact load AC15/DC13). PFH<sub>d</sub> values for small nominal loads on request.

Table 4.1: Safety-relevant characteristic data



### Notice!

Refer to the technical data for the slaves as well as to that for the sensors and actuators for the reaction times to be added.



### Attention!

The system reaction times of the daisy-chained AS-interface components are added up.

## System reaction times – example calculations

### System components:

<b>ASI1</b>	AS-interface network 1	
<b>ASI2</b>	AS-interface network 2	
<b>S1-1</b>	Safe sensor slave	(EMERGENCY-OFF switch: $t_{R S1-1} = 100ms$ )
<b>S1-2</b>	Safe sensor slave	(safety light barrier: $t_{R S1-2} = 18ms$ )
<b>S2-1</b>	Safe sensor slave	(EMERGENCY-OFF switch: $t_{R S2-1} = 100ms$ )
<b>A2-1</b>	Safe actuator slave	(motor starter: $t_{R A2-1} = 50ms$ )
<b>I1-1</b>	Standard AS-i 4E input slave, for integrating muting sensors	( $t_{\text{sensor signal interruption time}} = t_{SI} = 200ms$ ; ( $t_{\text{filter time-AS-i-I/O-signals}} = t_{ASI-F} = 25ms$ )
<b>MS</b>	Muting sensors	

- SM1-1**      Safety monitor ASM2E/1 with one relay output and one safe AS-interface output in AS-interface network 1
- SM1-2**      Safety monitor ASM1/1 with one relay output in AS-interface network 1
- SM2-1**      Safety monitor ASM2E/1 with one relay output and one safe AS-interface output in AS-interface network 2

## System configuration - example 1:

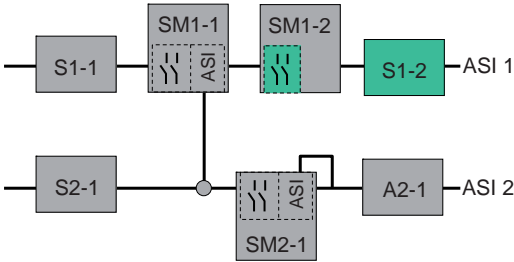


Figure 4.1: Example 1 - Calculation of the system reaction time

Upon activation of safety light barrier S1-2, the relay safety output of safety monitor SM1-2 is controlled.

Calculation of the AS-interface-relevant system reaction time:

$$t_{\text{System total a)}} = t_{\text{R S1-2}} + t_{\text{R system}} = 18\text{ms} + 40\text{ms} = \underline{58\text{ms}}$$

## System configuration - example 2:

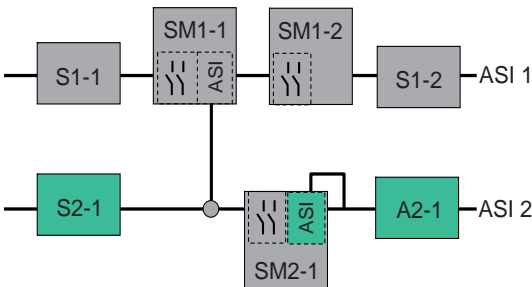


Figure 4.2: Example 2 - Calculation of the system reaction time

Upon locking of the EMERGENCY-OFF switch S2-1, the motor starter is controlled via the safe AS-interface output of safety monitor SM2-1.

Calculation of the AS-interface-relevant system reaction time:

$$t_{\text{System total b)}} = t_{\text{R S2-1}} + t_{\text{R system}} + t_{\text{R A2-1}} = 100\text{ms} + 40\text{ms} + 50\text{ms} = \underline{190\text{ms}}$$

**System configuration - example 3:**

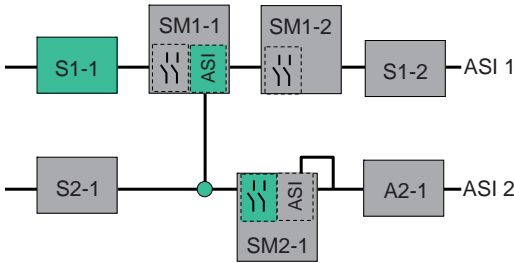


Figure 4.3: Example 3 - Calculation of the system reaction time

Upon locking of the EMERGENCY-OFF switch S1-1, the relay output of safety monitor SM2-1 is controlled via the coupling of the safe AS-interface output of safety monitor SM1-1.

Calculation of the AS-interface-relevant system reaction time:

$$t_{\text{System total c)}} = t_R \text{ S1-1} + t_R \text{ system ASI1} + t_R \text{ system ASI2} = 100\text{ms} + 40\text{ms} + 40\text{ms} = \underline{180\text{ms}}$$

**System configuration - example 4:**

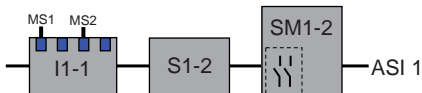


Figure 4.4: Example 4 - Calculation of the system reaction time

In the event the muting sequence of the muting sensors via the standard AS-i input slave I1-1 is faulty, the relay safety output is controlled by safety monitor SM1-2 while the transport material is brought into the safety light barrier S1-2.

Calculation of the AS-interface-relevant system reaction time:

$$\begin{aligned} t_{\text{total system d)}} &= t_R \text{ S1-2} + t_R \text{ system ASI1} + (t_{\text{SI I1-1}} + t_{\text{ASI-F}}) \\ &= 18\text{ms} + 40\text{ms} + (200\text{ms} + 25\text{ms}) = \underline{283\text{ms}} \end{aligned}$$

## 4.3 Dimensioned drawings

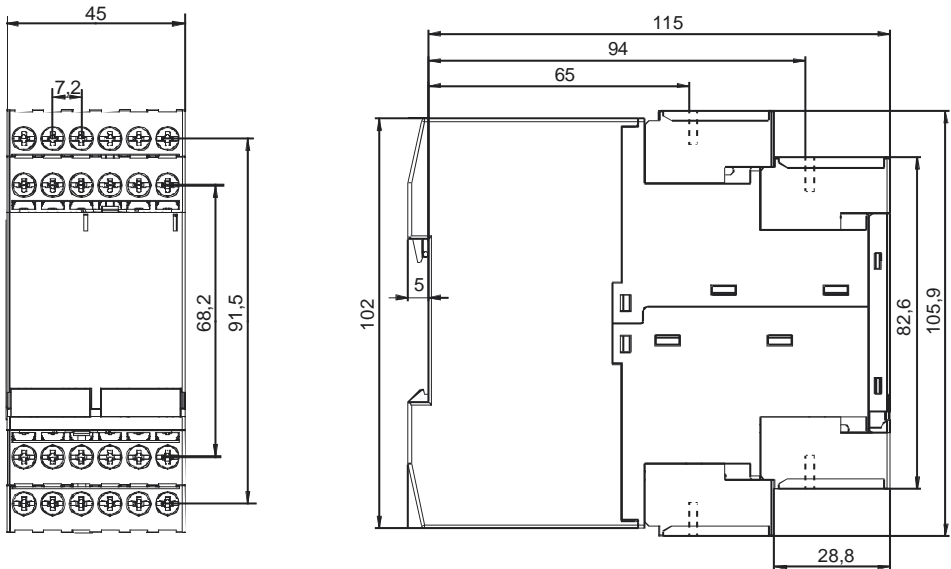


Figure 4.5: Dimensions

## 4.4 Scope of delivery

The **basic unit** consists of:

- AS-interface safety monitor ASM1/1, ASM1/2, ASM1E/1, ASM1E/2, ASM2E/1, ASM2E/2, ASM1E-m/1, ASM2E-m/1, ASM1E-m/2 or ASM2E-m/2

The following **accessories** are available:

- Configuration interface cable (RJ45/SubD 9 pin) for the PC/safety monitor connection
- Software CD with
  - **asimon** communication software for Microsoft® Windows 9x/Me/NT/2000/XP/Vista®/7
  - operating manual in PDF format
 (Adobe® Acrobat Reader® Version 4.x or newer is required for viewing the files)
- Operating manual
- Download cable (RJ45/RJ45) for the safety monitor/safety monitor connection
- Device front cover for protection and sealing

## 5 Mounting

### 5.1 Mounting in the switching cabinet

The AS-interface safety monitor is mounted on 35mm standard rails acc. to DIN EN 50022 in the switching cabinet.



**Attention!**

*The housing of the AS-interface safety monitor is not suitable for open wall mounting. Provide a protective housing in all cases when the device is not mounted in the switching cabinet.*

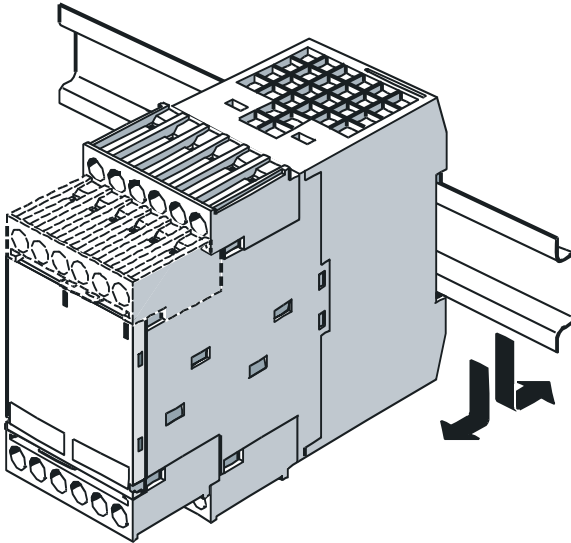


Figure 5.1: Mounting

To mount, position the device on the upper edge of the standard rail and then snap it onto the bottom edge. To remove, firmly press the device against the upper rail guide and lift out.



**Notice!**

*When drilling above the device, cover the AS-interface safety monitor. No particles, no metal shavings in particular, should be allowed to penetrate into the housing through ventilation openings as they may cause a short-circuit.*

*To prevent malfunctions, it is recommended that the operating temperature of the AS-interface safety monitor specified in the technical data for switching-cabinet installation be maintained. It is recommended that a minimum spacing of 10mm be maintained between multiple safety monitors and other switching cabinet components.*



## Removable connection terminals

The AS-interface safety monitor contains encoded, removable connection terminals (A, B, C, D in figure 5.2).

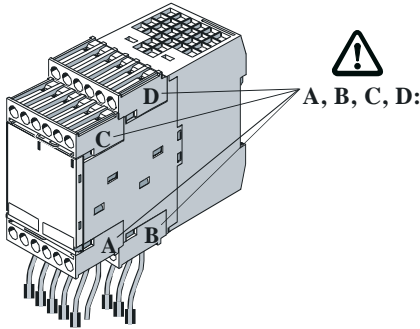


Figure 5.2: Removable connection terminals

To remove the encoded connection terminals, push back the safety spring **a** and pull the terminals out towards the front (figure 5.3). When mounting, the connection terminals must audibly lock into place.

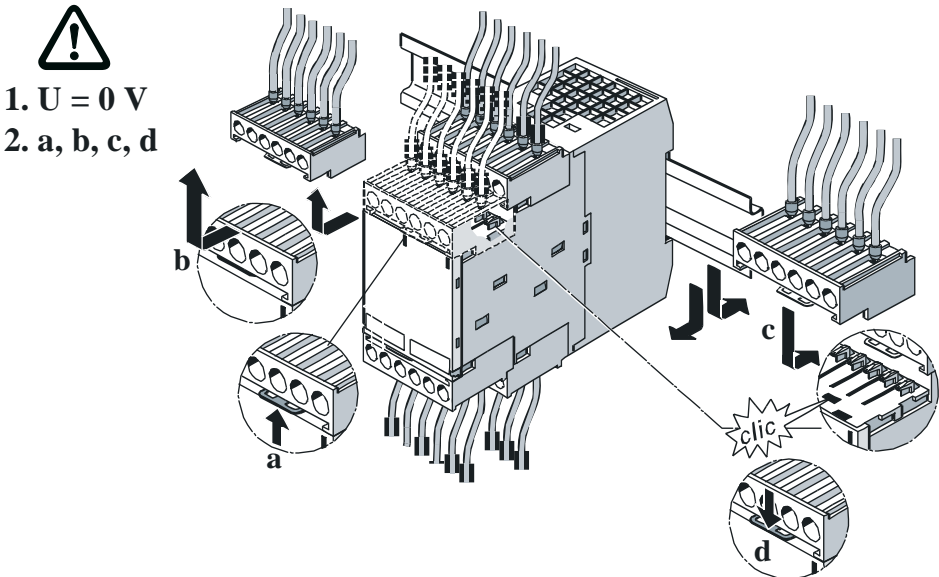


Figure 5.3: Removing and mounting encoded connection terminals

### Mounting accessories

As the AS-interface safety monitor is a safety component, it is possible to protect the device from unauthorized access by sealing the **CONFIG** configuration interface and the **Service** button. Included in the delivery contents for the device is a transparent cover with safety hook through which you can pass a lead sealing wire or thread when the device is in its mounted state (see figure 5.4). You must break the safety hook off the cover before using.

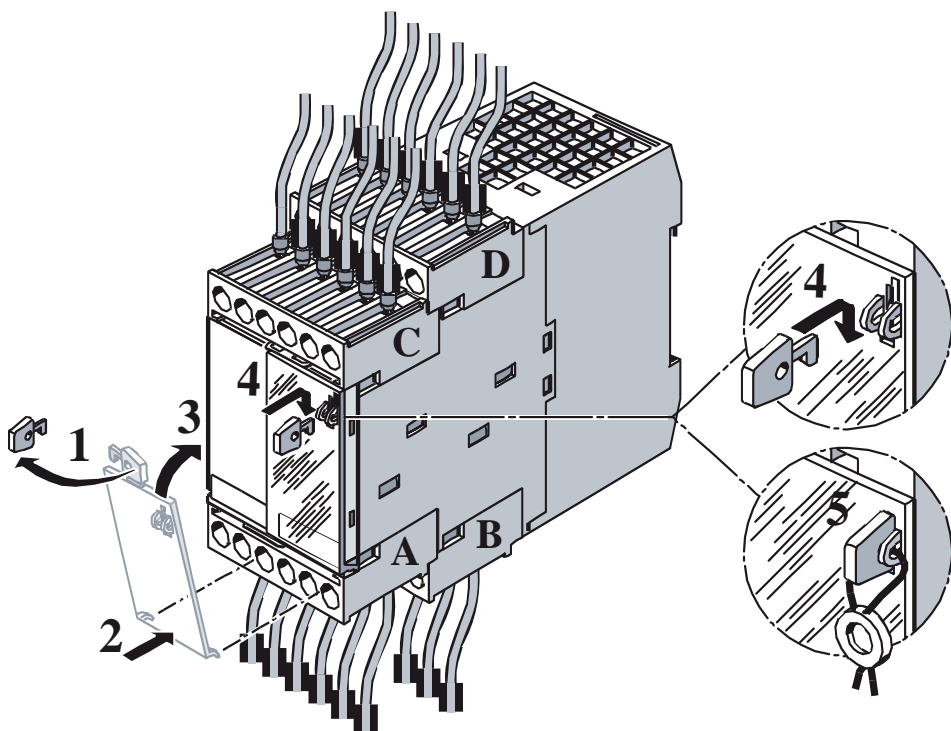


Figure 5.4: Mounting accessories for sealing the device



#### **Notice!**

The transparent cover with safety hook should always be used as they provide good protection against electrostatic discharges (ESD) and the penetration of foreign bodies into the **CONFIG** socket of the AS-interface safety-monitor configuration interface.

The sealing wire is not included in the delivery contents.

## 6 Electrical connection ASM1/1, ASM1E/1 and ASM1E-m/1



### Notice!

Work on electrical installations may only be carried out by qualified electricians.

### 6.1 Terminal assignment

#### Terminal arrangement / block diagram

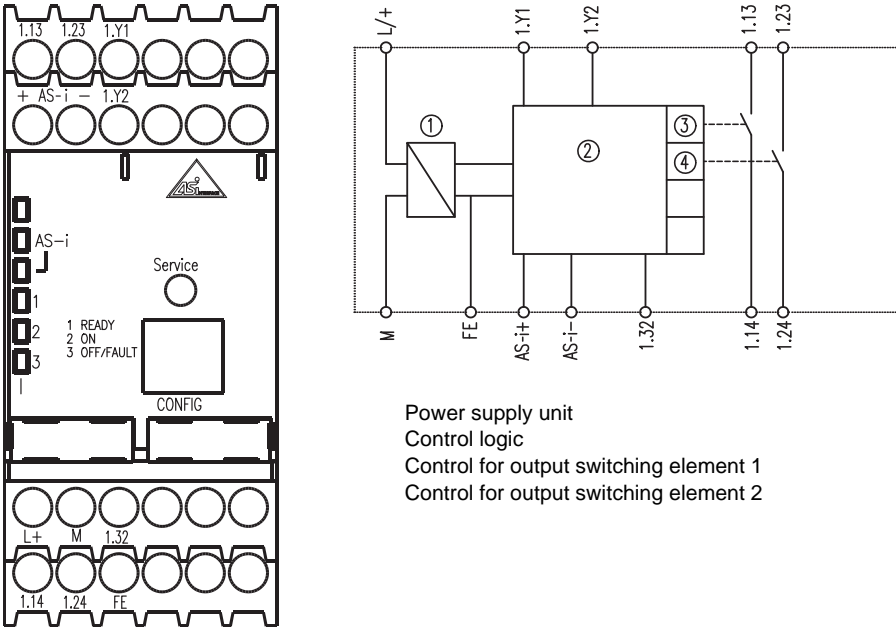


Figure 6.1: Terminal arrangement / block diagram of AS-interface safety monitor ASM1/1, ASM1E/1 and ASM1E-m/1

**Terminal assignment**

Terminal	Signal / description
AS-i+	Connection at the AS-interface bus
AS-i-	
L+	+24 V DC / supply voltage
M	GND / reference ground
FE	Functional earth
1.Y1	EDM 1 / input of external device monitoring circuit
1.Y2	Start 1 / start input
1.13 <sup>1)</sup>	Output switching element 1
1.14	
1.23 <sup>1)</sup>	Output switching element 2
1.24	
1.32	Message output "safety on"

1) Safeguard according to technical data

Table 6.1: Terminal assignment of AS-interface safety monitor ASM1/1, ASM1E/1 and ASM1E-m/1


**Notice!**

*The connection of the earth lead to terminal FE is not necessary if terminal M is connected to earth in the direct vicinity of the device.*


**Attention!**

*The AS-interface power supply unit for supplying the AS-interface components must demonstrate safe mains separation acc. to IEC 60742 and the ability to bridge short-term mains failures of up to 20ms. The power supply unit for 24V supply must also demonstrate safe mains separation acc. to IEC 60742 and the ability to bridge short-term mains failures of up to 20ms.*

## 6.2 Connection overview

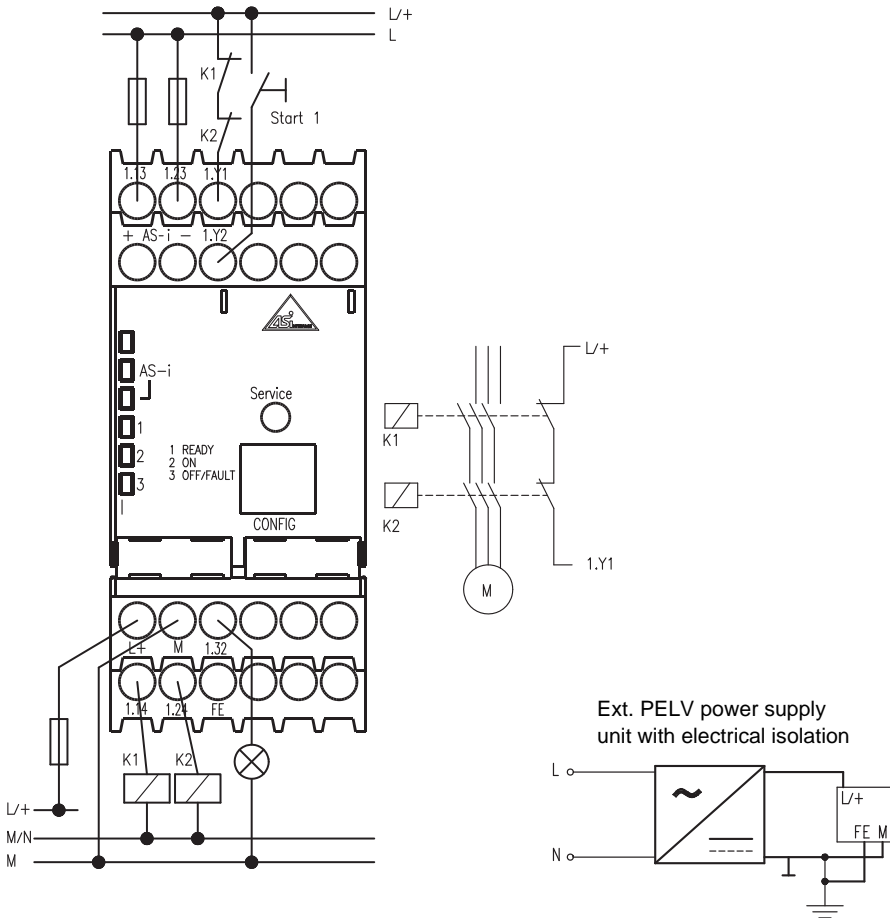


Figure 6.2: Connection overview of AS-interface safety monitor ASM1/1, ASM1E/1 and ASM1E-m/1

## 7 Electrical connection ASM1/2, ASM1E/2 and ASM1E-m/2

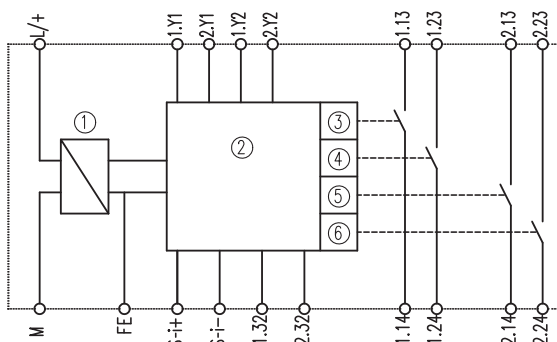
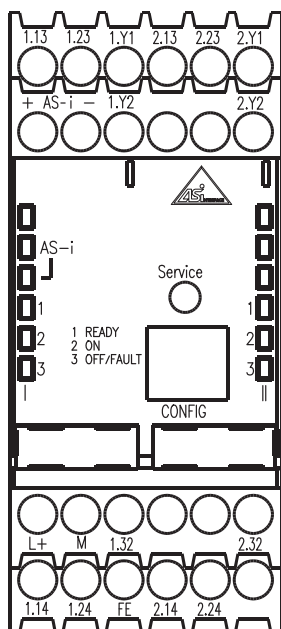


### **Notice!**

Work on electrical installations may only be carried out by qualified electricians.

### 7.1 Terminal assignment

#### Terminal arrangement



#### Power supply unit

#### Control logic

- Control for output switching element 1, output circuit 1
- Control for output switching element 2, output circuit 1
- Control for output switching element 1, output circuit 2
- Control for output switching element 2, output circuit 2

Figure 7.1: Terminal arrangement / block diagram of AS-i interface safety monitor  
ASM1/2, ASM1E/2 and ASM1E-m/2

**Terminal assignment**

Terminal	Signal / description
AS-i+	Connection at the AS-interface bus
AS-i-	
L+	+24V DC / supply voltage
M	GND / reference ground
FE	Functional earth
1.Y1	EDM 1 / input of external device monitoring circuit, output circuit 1
1.Y2	Start 1 / start input, output circuit 1
1.13 <sup>1)</sup>	Output switching element 1, output circuit 1
1.14	
1.23 <sup>1)</sup>	Output switching element 2, output circuit 1
1.24	
1.32	Message output 1 "Safety on", output circuit 1
2.Y1	EDM 2 / input of external device monitoring circuit, output circuit 2
2.Y2	Start 2 / start input, output circuit 2
2.13 <sup>1)</sup>	Output switching element 1, output circuit 2
2.14	
2.23 <sup>1)</sup>	Output switching element 2, output circuit 2
2.24	
2.32	Message output 2 "Safety on", output circuit 2

1) Safeguard according to technical data

Table 7.1: Terminal assignment of AS-interface safety monitor  
ASM1/2, ASM1E/2 and ASM1E-m/2

**Notice!**

*The connection of the earth lead to terminal FE is not necessary if terminal M is connected to earth in the direct vicinity of the device.*

**Attention!**

*The AS-interface power supply unit for supplying the AS-interface components must demonstrate safe mains separation acc. to IEC 60742 and the ability to bridge short-term mains failures of up to 20ms. The power supply unit for 24V supply must also demonstrate safe mains separation acc. to IEC 60742 and the ability to bridge short-term mains failures of up to 20ms.*

## 7.2 Connection overview

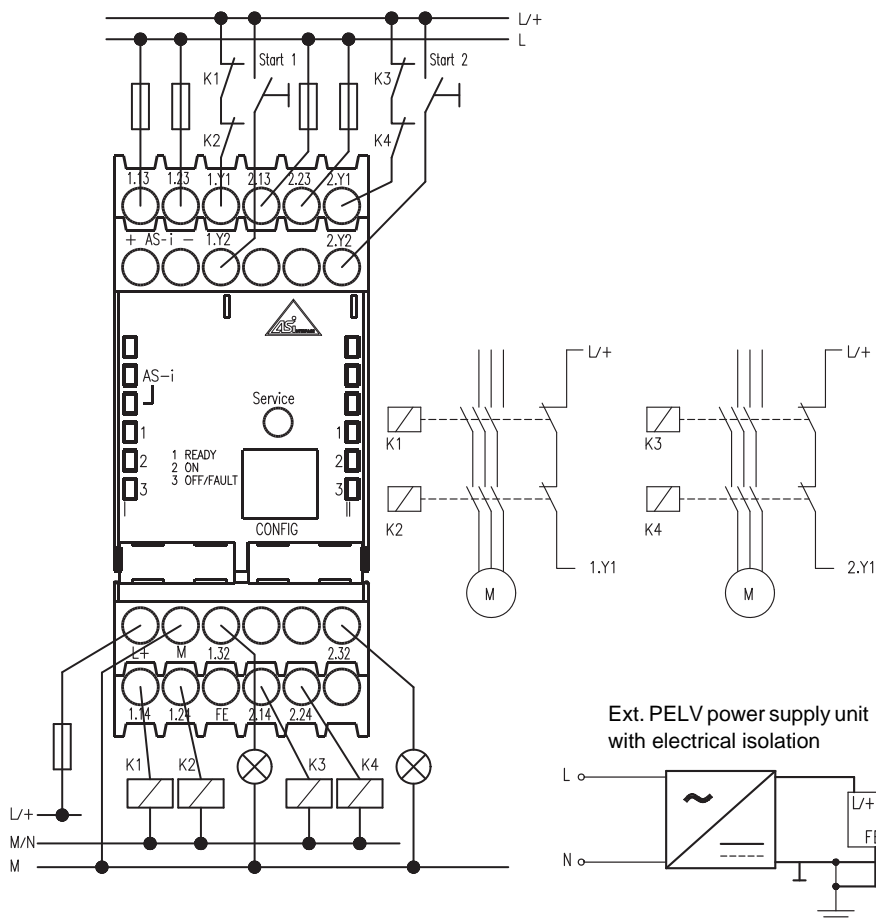


Figure 7.2: Connection overview of AS-interface safety monitor  
ASM1/2, ASM1E/2 and ASM1E-m/2



## 8 Electrical connection ASM2E/1, ASM2E/2, ASM2E-m/1 and ASM2E-m/2



### Notice!

Work on electrical installations may only be carried out by qualified electricians.

### 8.1 Terminal assignment

#### Terminal arrangement

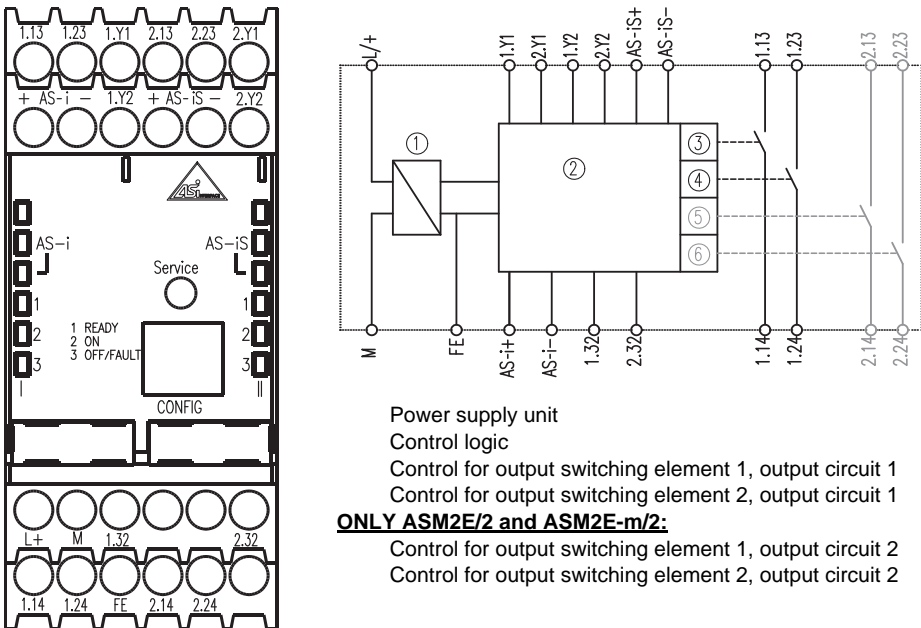


Figure 8.1: Terminal arrangement / block diagram of AS-interface safety monitor  
ASM2E/1, ASM2E/2, ASM2E-m/1 and ASM2E-m/2

**Terminal assignment**

Terminal	Signal / description
AS-i+	Connection at the AS-interface bus
AS-i-	
AS-iS+	Safe AS-interface output for actuator monitoring or coupling of another AS-interface network
AS-iS-	
L+	+24 V DC / supply voltage
M	GND / reference ground
FE	Functional earth
1.Y1	EDM 1 / input of external device monitoring circuit, output circuit 1
1.Y2	Start 1 / start input, output circuit 1
1.13 <sup>1)</sup>	Output switching element 1, output circuit 1
1.14	
1.23 <sup>1)</sup>	Output switching element 2, output circuit 1
1.24	
1.32	Message output 1 "Safety on", output circuit 1
2.Y1	EDM 2 / input of external device monitoring circuit, output circuit 2
2.Y2	Start 2 / start input, output circuit 2
2.13 <sup>1)</sup>	Output switching element 1, output circuit 2 ( <b>ASM2E/2 and ASM2E-m/2 only!</b> )
2.14	
2.23 <sup>1)</sup>	Output switching element 2, output circuit 2 ( <b>ASM2E/2 and ASM2E-m/2 only!</b> )
2.24	
2.32	Message output 2 "Safety on", output circuit 2

1) Safeguard according to technical data

Table 8.1: Terminal assignment of AS-interface safety monitor  
ASM2E/1, ASM2E/2, ASM2E-m/1 and ASM2E-m/2


**Notice!**

*The connection of the earth lead to terminal FE is not necessary if terminal M is connected to earth in the direct vicinity of the device.*


**Attention!**

*The AS-interface power supply unit for supplying the AS-interface components must demonstrate safe mains separation acc. to IEC 60742 and the ability to bridge short-term mains failures of up to 20ms. The power supply unit for 24V supply must also demonstrate safe mains separation acc. to IEC 60742 and the ability to bridge short-term mains failures of up to 20ms.*

**Attention!**

Make absolutely certain that terminals AS-iS+ and AS-iS- of the safe AS-interface output are properly connected acc. to chapter 8.2.1 or chapter 8.2.2.

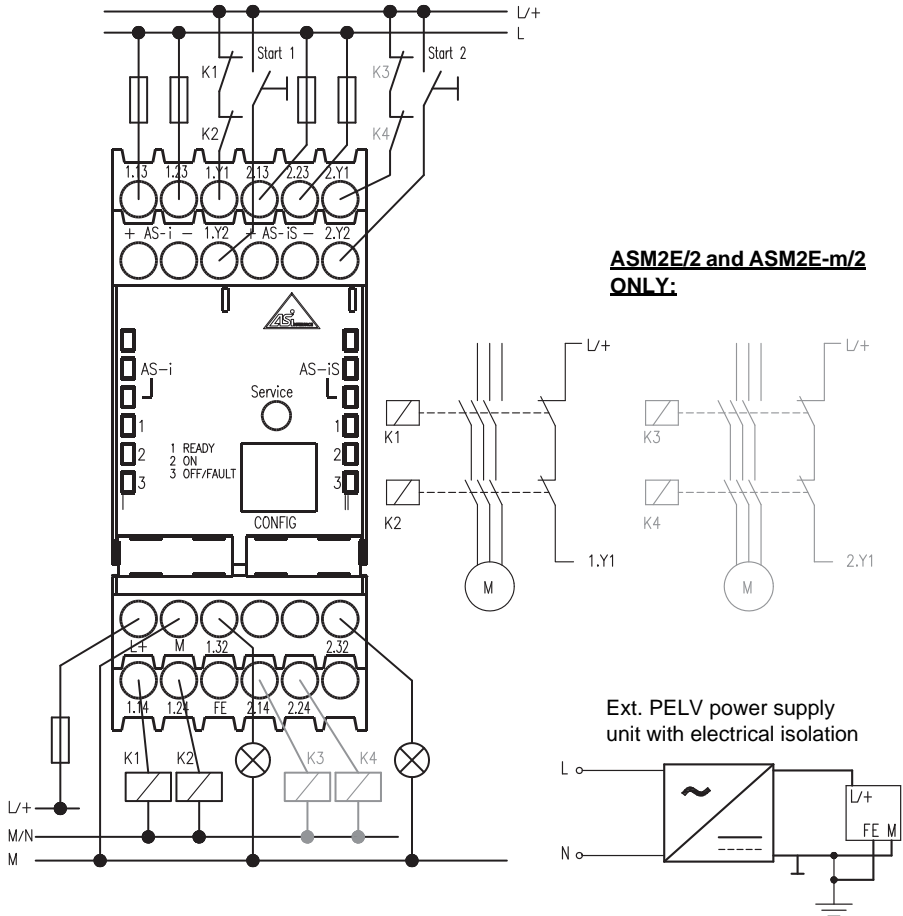
**8.2 Connection overview**

Figure 8.2: Connection overview of AS-interface safety monitor  
ASM2E/1, ASM2E/2, ASM2E-m/1 and ASM2E-m/2

**Notice!**

*With AS-interface safety monitor ASM2E/1 and ASM2E-m/1, the inputs for contactor monitoring (2.Y1) and start (2.Y2) as well as message output (2.32) are present in spite of the missing output switching elements for output circuit 2.*

**8.2.1 Connection for actuator monitoring**

 **Attention!**  
Terminal **AS-iS+** must be connected to **AS-i+** and **AS-iS-** must be connected to **AS-i-** of the same **AS-interface safety monitor**.

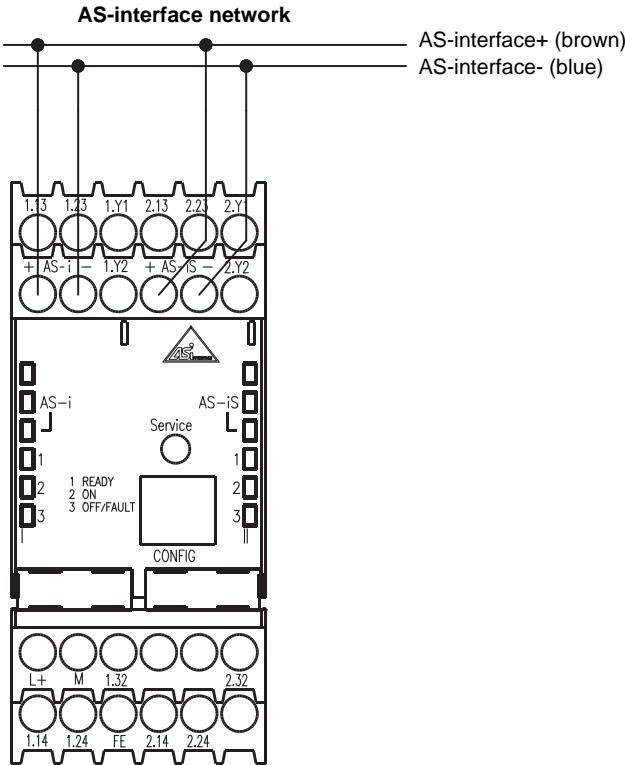


Figure 8.3: Connection of the terminals of the safe AS-interface output for actuator monitoring

## 8.2.2 Connection for coupling to another AS-interface network

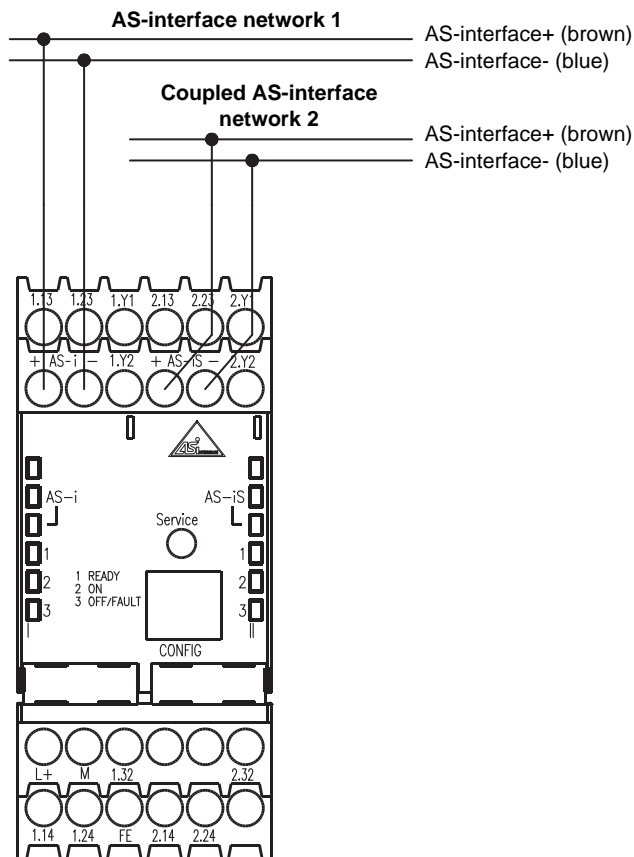


Figure 8.4: Connection of the terminals of the safe AS-interface output for network coupling

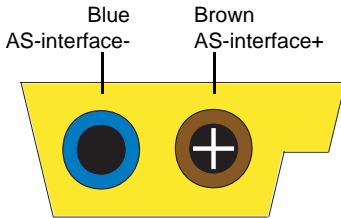
## 9 Electrical Connection of All Types

**Notice!**

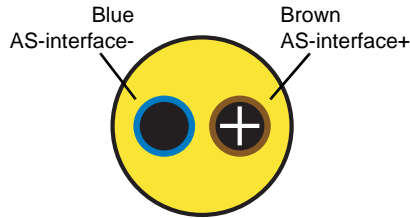
*Work on electrical installations may only be carried out by qualified electricians.*

*Unused terminals must remain unoccupied and must not be used for other functions!*

### 9.1 AS-interface bus connection



Yellow AS-interface ribbon cable



Two-conductor AS-interface round cable  
(recommended: flexible power cable  
H05VV-F2x1.5 acc. to DIN VDE 0281)

Figure 9.1: AS-interface cable variants

## 9.2 Serial interface

The serial RS 232C interface **CONFIG** is used for communication between PC and device and is permanently set to a baud rate of 9600 baud.

The interface is provided on the AS-interface safety monitor as an RJ45 socket. A matching interface cable with 9-pin subD connector is available as an accessory.



### **Attention!**

*Use only the optional interface cable. The use of other cables may lead to functional disturbances or damage to the connected AS-interface safety monitor.*

### Configuration interface RS 232C

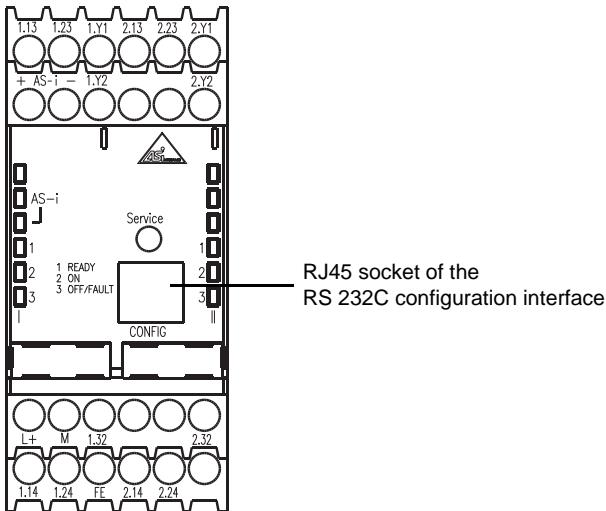


Figure 9.2: Location of the RS 232C configuration interface



## 10 Function and Commissioning

The configuration and commissioning of the AS-interface safety monitor is performed using a PC/notebook with the **asimon** configuration software.



### **Notice!**

*The description of the **asimon** software and the commissioning of the AS-interface safety monitor can be found in the "asimon - AS-interface safety monitor configuration software for Microsoft®-Windows®" manual.*

*The software manual is an important part of the operating manual for the AS-interface safety monitor. Configuration and commissioning of the AS-interface safety monitor is not possible without the **asimon** software.*

Configuration may be performed only by a safety officer. All commands relevant to safety are protected by a password.

### 10.1 Function and operating modes

With the AS-interface safety monitor, a distinction is made between 3 operating modes:

- Start-up operation
- Configuration operation
- Protective operation

#### 10.1.1 Start-up operation

After switching on, the microcontrollers in the AS-interface safety monitor first perform a system test of the hardware and internal software. If an internal device error is detected, the other device initialisation processes are stopped and the output switching elements remain switched off.

If all internal tests are completed successfully, the AS-interface safety monitor checks whether a valid, validated configuration is stored in the internal configuration memory.

If yes, this configuration is loaded, the necessary data structures assembled and the device switches to protective operation. Depending on the configuration, the output switching elements are then switched on or remain switched off.

If either no configuration or a faulty configuration is detected in the configuration memory, the device switches to configuration operation. The output switching elements remain switched off.

### 10.1.2 Configuration operation

In configuration operation of the AS-interface safety monitor, a command processing module is activated which communicates via the serial configuration interface with the **asimon** software installed on the PC/notebook (see the "asimon - AS-interface safety monitor configuration software for Microsoft®-Windows®" manual). Data transmission is monitored for transmission errors and, if necessary, repeated.

It is possible to switch to configuration operation by

- sending the password-protected command **stop** while in protective operation from the **asimon** software. Configured shutdown delay times are to be taken into account here.
- sending the command **stop** while in protective operation from the **asimon** software without entering a password. This is only possible if there is no communication on the AS-interface line. You can ensure that this is the case by, for example, directly disconnecting the AS-interface line from the monitor.
- detecting a missing or faulty configuration in start-up operation.
- pressing the **Service** button for the first time when replacing a defective safe AS-interface slave (see chapter 12.4 "Replacing defective safe AS-interface slaves").

### 10.1.3 Protective operation

Protective operation is the normal operating mode of the AS-interface safety monitor. In this mode the output switching elements are activated and deactivated depending on the operating state of the monitored safe AS-interface slaves and configured functional components.

In protective operation, the AS-interface safety monitor continuously transmits diagnostic data via the serial configuration interface. This data is processed by the **asimon** software.

If an internal error function is detected during protective operation of the AS-interface safety monitor, the output switching elements are switched off immediately and without regard to any set delay times. The AS-interface safety monitor then performs a self test again. If the error no longer exists, the AS-interface safety monitor returns to protective operation. If the error still exists, this state is error-locked and can be exited only by switching the AS-interface safety monitor back on.

It is possible to switch to protective operation by

- sending the command **start** while in configuration operation from the **asimon** software.
- detecting a valid, validated configuration in start-up operation.
- pressing the **Service** button for the second time when replacing a defective safe AS-interface slave (see chapter 12.4 "Replacing defective safe AS-interface slaves").

10.2 Display and operating elements

The LED indicators on the front side of the AS-interface safety monitor provide information about the operating mode and the device state.

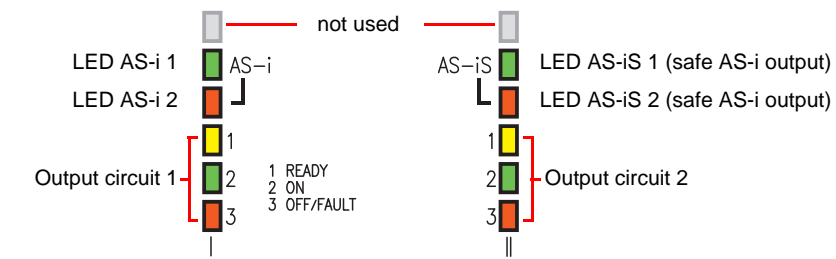






















Figure 10.1: Overview of device LEDs

Meanings of the LED indicators in protective operation

LED	Color		Meaning
AS-i 1		off	no supply
		green, continuous	AS-interface supply present
AS-i 2		off	normal operation
		red, continuous	communication error
AS-iS 1		off	no supply
		green, continuous	AS-interface supply present
AS-iS 2		off	normal operation
		red, continuous	communication error
1 READY (per output circuit)		off	—
		yellow, continuous	start-up/restart-disable active
		yellow, flashing	external test necessary / acknowledgement / delay before start-up active

LED	Color		Meaning
2 ON (per output circuit)		off	contacts of the output switching element open
		green, continuous	contacts of the output switching element closed
		green, flashing	delay time runs in event of Stop Category 1
3 OFF/FAULT (per output circuit)		off	contacts of the output switching element closed
		red, continuous	contacts of the output switching element open
		red, flashing	error on level of the monitored AS-interface components
1 READY 2 ON 3 OFF/FAULT (per output circuit)		simultaneously flashing rapidly	internal device error, error message can be queried by means of <b>asimon</b> software
			
			



**Notice!**

Pressing the **Service** button is acknowledged by a one-time, brief illumination of all device LEDs.



**Attention!**

Actuation force for the **Service** button: max. 1 N!

### 10.3 Switching on the device

As soon as the supply voltage is present at the device, the internal system test begins. This operating status is indicated by the switching on of all LEDs installed in the device (see chapter 10.1.1 "Start-up operation").

### 10.4 Device configuration and parameterization

For the device configuration and parameterization, you require the software program **asimon**.

The **asimon** software is responsible for the following tasks:

- Configuring the AS-interface safety monitor
- Documentation of the device configuration
- Commissioning the AS-interface safety monitor
- Diagnosis of the AS-interface safety monitor



**Notice!**

The description of the **asimon** program can be found in the separate software manual.

Configuration operation (chapter 10.1.2) is indicated by sequential illumination of LEDs 1 ... 3 of the output circuit 1.

Proceed as follows:

- Install the program on your PC.
- Apply the supply voltage to the AS-interface safety monitor.



**Notice!**

We recommend that before the user inserts the configuration cable into the safety monitor he perform a discharge (earthing) at a suitable location.

- Use the interface cable (RJ45/SubD 9-pin) to connect the PC to the AS-interface safety monitor (see chapter 2.1.2 "Connection between the AS-interface safety monitor and the PC" of the software manual).
- Configure the AS-interface safety monitor and put it into operation as described in the software manual.
- The AS-interface safety monitor is ready for operation following commissioning.



**Attention!**

Before commissioning the device you **must** adapt the device configuration to your application. To do this, configure the AS-interface safety monitor as described in the software manual in such a way that the given danger area is protected by the device.

## 10.5 Technical safety documentation for the application



**Attention!**

The validated configuration log signed by the safety officer must be filed with the safety documentation of the user application.



**Notice!**

The detailed description of the technical safety documentation for the configuration of your application can be found in the separate software manual.

Proceed as follows:

- Create the AS-interface safety monitor configuration for your application.
- Validate the configuration (to be performed by the safety officer).
- Print out the final configuration log and, optionally, the configuration overview (see chapter 5.8 "Configuration documentation" of the software manual).
- Sign the final configuration log (to be performed by the safety officer).
- File the log together with the other technical safety documentation for your application (machine documentation) and store in a safe location.

## 11 Maintenance

### 11.1 Checking for safe shutdown

The proper function of the AS-interface safety monitor within the system to be secured, i.e. the safe shutdown following the triggering of an assigned safe sensor or switch, is to be checked at least annually by the safety officer.

**Attention!**

*This is to be performed by activating each safe AS-interface slave at least once per year and visually inspecting the switching behaviour of the output circuits of the AS-interface safety monitor.*

**Attention!**

*The specified PFD and PFH<sub>d</sub> values refer to a maximum switch-on time of 12 months (PFD) and a maximum lifespan of 20 years acc. to EN ISO 13849-1.*

## 12 Status Display, Errors and Error Rectification

### 12.1 Status display on the device / error diagnosis on the PC

An internal or external error is indicated by the red flashing LED **OFF/FAULT** on the AS-interface safety monitor (see chapter 10.2 "Display and operating elements").



#### **Notice!**

A more exact diagnosis of the error is possible via the configuration interface using the **asimon** software (see software manual).

### 12.2 Troubleshooting tips

Error	Possible cause	Remedy
<b>LED AS-i 1</b> is off	No AS-interface supply	<ul style="list-style-type: none"> <li>• Check line connections</li> <li>• Check AS-interface power supply unit</li> </ul>
<b>LED AS-i 2</b> illuminates red	Communication on the AS-interface bus is faulty	<ul style="list-style-type: none"> <li>• Check line connections</li> <li>• Check AS-interface master</li> </ul>
<b>LED AS-IS 1</b> is off	No AS-interface supply	<ul style="list-style-type: none"> <li>• Check line connections</li> <li>• Check AS-interface power supply unit</li> </ul>
<b>LED AS-IS 2</b> illuminates red	Communication on the AS-interface bus is faulty	<ul style="list-style-type: none"> <li>• Check line connections</li> <li>• Check AS-interface master</li> </ul>
<b>LED 3 OFF/FAULT</b> flashes red	Error on level of the monitored AS-interface components	<ul style="list-style-type: none"> <li>• Perform diagnostics with <b>asimon</b></li> <li>• If necessary, replace defective AS-interface components</li> </ul>
<b>LEDs 1 ... 3</b> simultaneously flashing rapidly	Internal device error	<ul style="list-style-type: none"> <li>• Note down the error numbers displayed by <b>asimon</b> in the error message window and contact the manufacturer</li> </ul>

### 12.3 Error release with the "Service" button

An error-locked safety monitor (red LED **3 OFF/FAULT** flashes) can be released by pressing the "Service" button. The device with the error is reset when the button is pressed. A start test must be performed on this device after the reset.



#### **Notice!**

Pressing the **Service** button is acknowledged by a one-time, brief illumination of all device LEDs.

## 12.4 Replacing defective safe AS-interface slaves



### **Notice!**

*The exchange of defective safety-oriented AS-interface slaves with connected AS-interface cable results in a device error (flashing LEDs, see chapter 10.2 "Display and operating elements"). The AS-interface safety monitor enters the error state.*

- ✚ Disconnect all defective AS-interface slaves from the AS-interface cable without fail before replacement.



### **Notice!**

*When exchanging defective safety-oriented AS-interface slaves **without a PC**, a PC interface cable may **not** be connected to the 'CONFIG' socket of the AS-interface safety monitor.*

### 12.4.1 Replacing a defective safe AS-interface slave

If a safe AS-interface slave is defective, it is possible to replace it without a PC and without reconfiguring the AS-interface safety monitor by using the **Service** button on the AS-interface safety monitor.



### **Attention!**

*Actuation force for the **Service** button: max. 1 N!*



### **Notice!**

*When the **Service** button is pressed, the safety monitor switches from protective operation to configuration operation. The output circuits are therefore deactivated in all cases.*

*Pressing the **Service** button is acknowledged by a one-time, brief illumination of all device LEDs.*

Proceed as follows:

1. Disconnect the defective AS-interface slave from the AS-interface line.
2. Press the **Service** button for approx. 1 second on all AS-interface safety monitors which use the defective safe AS-interface slave.
3. Connect the new safe AS-interface slave to the AS-interface line.
4. Press the **Service** button again for approx. 1 second on all AS-interface safety monitors which use the replaced safe AS-interface slave.

The first time the **Service** button is pressed, the monitor determines whether exactly one slave is missing. This is noted in the error memory of the AS-interface safety monitor. The AS-interface safety monitor switches to configuration operation. The second time the **Service** button is pressed, the code sequence of the new slave is read in and checked for correctness. If the code sequence is OK, the AS-interface safety monitor returns to protective operation.



### **Attention!**

*After replacing a defective safe slave, make certain to check the new slave for correct function.*



### 12.4.2 Replacing several defective safe AS-interface slaves

If more than one safe AS-interface slave on an AS-interface branch is defective, the devices must be replaced in the following way:



**Notice!**

When the **Service** button is pressed, the safety monitor switches from protective operation to configuration operation. The output circuits are therefore deactivated in all cases.

Pressing the **Service** button is acknowledged by a one-time, brief illumination of all device LEDs.



**Attention!**

Actuation force for the **Service** button: max. 1N!

1. Disconnect all defective AS-interface slaves from the AS-interface line. Connect all new, **already addressed** safe AS-interface slaves **except one** to the AS-interface line (Auto\_Address does not function in this case).
2. Activate all newly connected slaves so that no code sequences are sent by the slave (actuate emergency shutdown, open door, break light barrier, etc.).



**Notice!**

The error detection function integrated in the monitor only accepts a new slave if point 2 is fully observed.

3. Press the **Service** button for approx. one second on all AS-interface safety monitors which used the defective safe AS-interface slaves.
4. Connect the last missing and already addressed slave to the AS-interface line.
5. Press the **Service** button for approx. one second on all AS-interface safety monitors which used the defective safe AS-interface slaves.
6. Disconnect one of the replaced and not yet taught AS-interface slaves from the AS-interface line.
7. Press the **Service** button for approx. one second on all AS-interface safety monitors which used the defective safe AS-interface slaves.
8. Reconnect the previously disconnected AS-interface slave to the AS-interface line.
9. Activate the newly connected slave. The code sequence is now transmitted to the AS-interface safety monitor and stored there.
10. Press the **Service** button for approx. one second on all AS-interface safety monitors which used the defective safe AS-interface slaves.
11. Repeat the procedure from step 6 onwards until all replaced AS-interface slaves have been taught.

The first time the **Service** button is pressed, the monitor determines whether exactly one slave is missing. This is noted in the error memory of the AS-interface safety monitor. The AS-interface safety monitor switches to configuration operation. The second time the **Service** button is pressed, the code sequence of the new slave is read in and checked for correctness. If the code sequence is OK, the AS-interface safety monitor returns to protective operation.



**Attention!**

*After replacing the defective safe slaves, make certain to check the new slaves for correct function.*

### 12.5 Replacing a defective AS-interface safety monitor

If an AS-interface safety monitor is defective and must be replaced, the replacement device does not necessarily need to be reconfigured using the **asimon** software. It is possible instead to transfer the configuration from the defective device to the replacement device using the download cable (optional accessory).

#### Requirements:

- A download cable must be available (see accessories in chapter 4.4).
- The replacement device must not have a valid configuration stored in its configuration memory.



#### **Notice!**

*If an AS-interface safety monitor which was previously used somewhere else is now to be used as a replacement device, you must replace the existing old configuration with a new configuration which, however, you should not validate.*

#### **AS-interface safety monitor version < V2.12:**

Proceed as follows:

- Disconnect the defective AS-interface safety monitor from the supply.
- Use the download cable (RJ45/RJ45) to connect the defective device to the replacement device.
- Apply the supply voltage to the replacement device.
- The configuration of the defective device is now automatically transferred to the replacement device.

Active transmission is indicated by the continuous illumination of the yellow **READY** LED. Conclusion of a successful transmission is indicated by the continuous illumination of the yellow **READY** LED and the green **ON** LED.

- Disconnect the new AS-interface safety monitor from the supply and disconnect the download cable from both devices. The replacement device can now directly be used in the place of the defective device.

#### **AS-interface safety monitors version ≥ V2.12:**

Proceed as follows:

- Disconnect the defective AS-interface safety monitor from the supply and uninstall it.
- Install the new AS-interface safety monitor and connect it (connections L+, M and FE as well as AS-i+ and AS-i- as well as additional connections as necessary).
- Switch on the supply voltage for the new AS-interface safety monitor. The AS-interface safety monitor enters configuration operation.
- Connect the defective AS-interface safety monitor, which is not connected to voltage, to the new AS-interface safety monitor via the download cable (RJ45/RJ45) and press the **Service** button.
- The AS-interface safety monitor restarts (LED test) and the configuration is transferred. During transfer, the **1 READY** yellow LED illuminates.
- When the **1 READY** yellow LED goes out, transfer has concluded. Disconnect the two AS-interface safety monitors from one another and press the **Service** button again.
- The AS-interface safety monitor restarts and now operates with the transferred configuration.



#### **Attention!**

*After replacing a defective AS-interface safety monitor, make certain to check the new AS-interface safety monitor for proper function.*

## 12.6 What to do if you forget the password



### **Attention!**

*Only the responsible safety officer is permitted to retrieve a lost password in the way described below!*

If you have lost the password for your configuration, proceed as follows:

1. Find the valid configuration log (printout or file) of the AS-interface safety monitor for which you no longer have a password. In the configuration log, find a four-digit code in line 10 (Monitor Section, Validated).
  - If the configuration log is unavailable and the AS-interface safety monitor is not to be switched to configuration operation, connect the AS-interface safety monitor for which you no longer have a password to the PC and start the **asimon** software.
  - Select a neutral configuration and start the diagnostic function in **asimon** with **Monitor -> Diagnose**. Now wait until the current configuration appears on the screen. This can take up to five minutes.
  - Open the **Information about monitor and bus** window (menu item **Edit -> Information about monitor and bus ...**). In the **Title** tab you will again find the four-digit code in the **Download time** window area.
2. Contact the technical support department of your supplier and state the four-digit code.
3. A **master password** can be generated from this code. This password allows you to access to the stored configuration again.
4. Use the master password to stop the AS-interface safety monitor and to enter a new user password. To do so, select **Change password...** in the **Monitor** menu of the **asimon** configuration software.



### **Attention!**

*Please note that accessing the configuration stored in the AS-interface safety monitor can affect the reliability of the system. Changes to validated configurations should only be made by authorized personnel. All changes must be made in accordance with the instructions given in the user manual supplied with the **asimon** configuration software.*



### **Notice!**

*If no valid configuration has yet been stored in the AS-interface safety monitor, the default password "SIMON" is valid.*

## 13 Diagnostics via AS-interface

### 13.1 General procedure



#### **Notice!**

*The assignment of an **AS-interface slave address for the AS-interface safety monitor** is a prerequisite for diagnosing the AS-interface safety monitor on the AS-interface master.*

Using the AS-interface bus, diagnostics of the AS-interface safety monitor and configured devices is possible from the AS-interface master, normally a PLC with master module.

However, to ensure reliable transmission and efficient evaluation of the diagnostic data, a series of requirements must be satisfied:

- Relatively long telegram propagation times may occur, particularly when using an additional bus system between PLC and AS-interface. Owing to the asynchronous transmission in the master in the case of two successive, identical data calls, the PLC may not necessarily know when the AS-interface safety monitor is responding to the new call. Thus, the answers to two successive, different data calls should differ by at least one bit.
- The diagnostic data must be consistent, i.e. the status information sent by the AS-interface safety monitor must match the actual device states, especially if the propagation time to the PLC is longer than the updating time in the AS-interface safety monitor (approx. 30 ... 150ms).
- Whether a deactivated relay of an output circuit represents the normal state depends on the operating mode of the AS-interface safety monitor. The diagnostics in the PLC should only be called in the event of a deviation from the normal state.

The diagnostic procedure described below satisfies these requirements and should therefore always be followed.

### ***Diagnostic procedure***

The PLC always queries the AS-interface safety monitor alternately with two data calls (0) and (1). These data calls return the basic information (state of the output circuits, protective/configuration operation) to allow a diagnostics. The AS-interface safety monitor answers the two calls with the same user data (3 bit, D2 ... D0). Bit D3 is a control bit, similar (but not identical) to a toggle bit. D3 is 0 for all even data calls (0); D3 is 1 for all odd data calls (1). This enables the PLC to detect whether the answer has changed.

Data calls (0) and (1) return the answer X000 if the normal state exists (protective operation, everything OK). For devices with only one output circuit and with two dependent output circuits, output circuit 2 is always marked as OK. With two independent output circuits, an unconfigured circuit is also marked as OK. In order to be able to interpret what is OK and what is not OK, the user must be familiar with his configuration.

If the data call changes from (0) to (1), the data set is stored in the AS-interface safety monitor. Bit D3 in the answer, however, remains reset until the process is concluded. As a result, the PLC thinks it has received answers to data call (0). If D3 is set, a consistent data set exists.

If, with the bit D3 set, the answer from the AS-interface safety monitor signals deactivation of an output circuit, detailed diagnostic information can now be queried in the stored state with the specific data calls (2) ... (B). Depending on the setting in the configuration of the AS-interface safety monitor, data calls (4) ... (B) return device diagnostic information sorted according to output circuit (see section 13.2.2) or unsorted (see section 13.2.3).



**Notice!**

*If the AS-interface safety monitor is in configuration operation, it is not possible to query the detailed diagnostic information using the data calls (2) ... (B).*

A fresh data call (0) cancels the stored state again.

## 13.2 Telegrams

### 13.2.1 Diagnostics of AS-interface safety monitor

#### State of output circuits, operating mode



**Notice!**

*The alternate sending of data calls (0) and (1) is essential for consistent data transmission. see "Diagnostic procedure" on page 84.*

***The binary values of the data calls relate to the AS-interface level and may possibly be inverted at PLC level.***

Data call / Value	Answer D3 ... D0	Meaning
(0) / 0000 State of monitor	0000	Protective operation, everything OK (unavailable, unconfigured or dependent output circuits are displayed as OK)
	0001	Protective operation, output circuit 1 off
	0010	Protective operation, output circuit 2 off
	0011	Protective operation, both output circuits off
	0100	Configuration operation: Power On
	0101	Configuration operation
	0110	Reserved / not defined
	0111	Configuration operation, fatal device error, RESET or device exchange required
	1XXX	No up-to-date diagnostic information available, please wait

Data call / Value	Answer D3 ... D0	Meaning
(1) / 0001 Save diagnostic information (state of monitor)	1000	Protective operation, everything OK (unavailable, unconfigured or dependent output circuits are displayed as OK)
	1001	Protective operation, output circuit 1 off
	1010	Protective operation, output circuit 2 off
	1011	Protective operation, both output circuits off
	1100	Configuration operation: Power On
	1101	Configuration operation
	1110	Reserved / not defined
	1111	Configuration operation, fatal device error, RESET or device exchange required

### State of device LEDs

Data calls (2) and (3) return a simplified indication of the output circuit LEDs (see chapter 10.2) on the AS-interface safety monitor.

If answer to data call (1) = 10XX:

Data call / Value	Answer D3 ... D0	Meaning
(2) / 0010 State of LEDs of output circuit 1	0000	Green = contacts of output circuit closed
	0001	Yellow = startup/restart-disable active
	0010	Yellow flashing or red = contacts of output circuit open
	0011	Red flashing = error on level of the monitored AS-interface components
	01XX	Reserved

Data call / Value	Answer D3 ... D0	Meaning
(3) / 0011 State of LEDs of output circuit 2	1000	Green = contacts of output circuit closed
	1001	Yellow = startup/restart-disable active
	1010	Yellow flashing or red = contacts of output circuit open
	1011	Red flashing = error on level of the monitored AS-interface components
	11XX	Reserved

## Color coding



### **Notice!**

The color of a device corresponds to the color of the virtual LEDs in the diagnostic view of the **asimon** configuration software. A device which is not assigned to any output circuit is always shown in green.

Code CCC (D2 ... D0)	Color	Meaning
000	green, continuous	Device is in the ON state (switched on)
001	green, flashing	Device is in the ON state (switched on), but already in the process of being switched to the OFF state, e.g. switch-off delay
111	green/yellow	Notice! Safe actuator - manufacturer dependent, see technical description of the safe AS-interface actuator slave
010	yellow, continuous	Device is ready, but is still waiting for another condition, e.g. local acknowledgement or start button
011	yellow, flashing	Time condition exceeded, action must be repeated, e.g. synchronization time exceeded
100	red, continuous	Device is in the OFF state (switched off)
101	red, flashing	The error lock is active, release by means of one of the following actions: <ul style="list-style-type: none"> <li>• Acknowledge with the service button</li> <li>• Power OFF/ON</li> <li>• AS-interface bus OFF/ON</li> </ul>
110	gray, off	No communication with the AS-interface slave

Table 13.1: Color coding



### **Notice!**

During proper protective operation, there are also devices which are not in the green state. When searching for the cause of a shutdown, the device with the lowest device index is the most important. Others may just be subsequent effects (example: when the emergency shutdown button is pressed, the start device and timer are also in the OFF state).

By appropriately programming the functional component in the PLC, the user can be guided to the primary cause of the error. Detailed knowledge of the configuration and the function of the AS-interface safety monitor are necessary for the interpretation of additional information.

Because the device numbers can be shifted if the configuration is changed, we recommend using the diagnostics index assignment.



### Coding of the colors for muting/muting start devices


**Notice!**

The color of a device corresponds to the color of the virtual LEDs in the diagnostic view of the **asimon** configuration software. A device which is not assigned to any output circuit is always shown in green.

#### Muting devices

Code CCC (D2 ... D0)	Color	Meaning
000	green, continuous	Muting device is in the ON state (switched on)
001	green, flashing	Muting device is in the ON state (switched-on), muting is active
010	yellow, continuous	Muting device is in the ON state (switched on), muting error
011	yellow, flashing	Muting device is in the OFF state (switched off), Error during muting time limiting (timeout)
100	red, continuous	Muting device is in the OFF state (switched off)
101	red, flashing	Muting device is in the OFF state (switched off), muting error

Table 13.2: Coding of the colors for muting devices

#### Muting start devices

Code CCC (D2 ... D0)	Color	Meaning
000	green, continuous	Muting start button was actuated for the first time
001	green, flashing	Muting start button was actuated for the second time
010	yellow, continuous	Muting start device is ready
011	yellow, flashing	Pause after first actuation of the muting start button
100	red, continuous	Muting start button was pressed too long
101	red, flashing	Muting start button is pressed continuously

Table 13.3: Coding of the colors for muting start devices

### 13.2.2 Diagnosis of devices, sorted according to OSSD

With the appropriate configuration setting, data calls (4) ... (B) return device diagnostic information sorted according to output circuit.



**Notice!**

Make sure that the correct diagnostics type is set for the AS-interface safety monitor in the **Information about monitor and bus** window of the **asimon** configuration software.

The values returned in calls (5) and (6) as well as (9) and (A) refer to the device diagnostics index in the configuration program and not to an AS-interface address.

Always execute data calls (4) ... (7) and (8) ... (B) together in sequence for each device.

#### Sorted device diagnostics, output circuit 1

If answer to data call (1) = 10X1:

Data call / Value	Answer D3 ... D0	Meaning
(4) / 0100 Number of devices not green, output circuit 1	0XXX	XXX = 0: no devices, answers to data calls (5) ... (7) not relevant XXX = 1 ... 6: number of devices in output circuit 1 XXX = 7: number of devices is > 6 in output circuit 1
Data call / Value	Answer D3 ... D0	Meaning
(5) / 0101 Device address HIGH, output circuit 1	1HHH	HHH = I5,I4,I3: diagnostics index of device in output circuit 1 of configuration (HHHLLL = diagnostics index)
Data call / Value	Answer D3 ... D0	Meaning
(6) / 0110 Device address LOW, output circuit 1	0LLL	LLL = I2,I1,I0: diagnostics index of device in output circuit 1 of configuration (HHHLLL = diagnostics index)
Data call / Value	Answer D3 ... D0	Meaning
(7) / 0111 Color of device, out- put circuit 1	1CCC	CCC = color (see table 13.1 on page 87)

#### Sorted device diagnostics, output circuit 2

If answer to data call (1) = 101X:

Data call / Value	Answer D3 ... D0	Meaning
(8) / 1000 Number of devices not green, output circuit 2	0XXX	XXX = 0: no devices, answers to data calls (5) ... (7) not relevant XXX = 1 ... 6: number of devices in output circuit 2 XXX = 7: number of devices is > 6 in output circuit 2
Data call / Value	Answer D3 ... D0	Meaning
(9) / 1001 Device address HIGH, output circuit 2	1HHH	HHH = I5,I4,I3: diagnostics index of device in output circuit 2 of configuration (HHHLLL = diagnostics index)
Data call / Value	Answer D3 ... D0	Meaning
(A) / 1010 Device address LOW, output circuit 2	0LLL	LLL = I2,I1,I0: diagnostics index of device in output circuit 2 of configuration (HHHLLL = diagnostics index)
Data call / Value	Answer D3 ... D0	Meaning
(B) / 1011 Color of device, output circuit 2	1CCC	CCC = color (see table 13.1 on page 87)

**Notice!**

Data calls (C) 0011 to (F) 0000 are reserved.

### 13.2.3 Diagnosis of devices, unsorted

With the appropriate configuration setting, data calls (4) ... (B) return unsorted device diagnostic information for all devices.



**Notice!**

*Make sure that the correct diagnostics type is set for the AS-interface safety monitor in the **Information about monitor and bus** window of the **asimon** configuration software.*

*The values returned in calls (5) and (6) as well as (9) and (A) refer to the device diagnostics index in the configuration program and not to an AS-interface address.*

*Always execute data calls (4) ... (7) and (8) ... (B) together in sequence for each device.*

#### **Unsorted device diagnostics, all devices**

If answer to data call (1) = 1001, 1010 or 1011:

Data call / Value	Answer D3 ... D0	Meaning
(4) / 0100 Number of devices not green, continuous	0XXX	XXX = 0: no devices, answers to data calls (5) ... (7) not relevant. XXX = 1 ... 6: number of devices not green. XXX = 7: number of devices not green is > 6 (for colors, see table 13.1 on page 87).
Data call / Value	Answer D3 ... D0	Meaning
(5) / 0101 Device address HIGH	1HHH	HHH = I5,I4,I3: diagnostics index of device of configuration (HHHLLL = diagnostics index).
Data call / Value	Answer D3 ... D0	Meaning
(6) / 0110 Device address LOW	0LLL	LLL = I2,I1,I0: diagnostics index of device of configuration (HHHLLL = diagnostics index).
Data call / Value	Answer D3 ... D0	Meaning
(7) / 0111 Color of device	1CCC	CCC = color (see table 13.1 on page 87).
Data call / Value	Answer D3 ... D0	Meaning
(8) / 1000	0XXX	Not used

Data call / Value	Answer D3 ... D0	Meaning
(9) / 1001 Device address HIGH	1HHH	HHH = I5,I4,I3: diagnostics index of device of configuration (HHHLLL = diagnostics index).
Data call / Value	Answer D3 ... D0	Meaning
(A) / 1010 Device address LOW	0LLL	LLL = I2,I1,I0: diagnostics index of device of configuration (HHHLLL = diagnostics index).
Data call / Value	Answer D3 ... D0	Meaning
(B) / 1011 Assignment to output circuit	10XX	XX = 00: device from pre-processing XX = 01: device from output circuit 1 XX = 10: device from output circuit 2 XX = 11: device from both output circuits

**Notice!**

Data calls (C) 0011 to (F) 0000 are reserved.

### 13.3 Example: Querying with diagnostics sorted according to OSSD

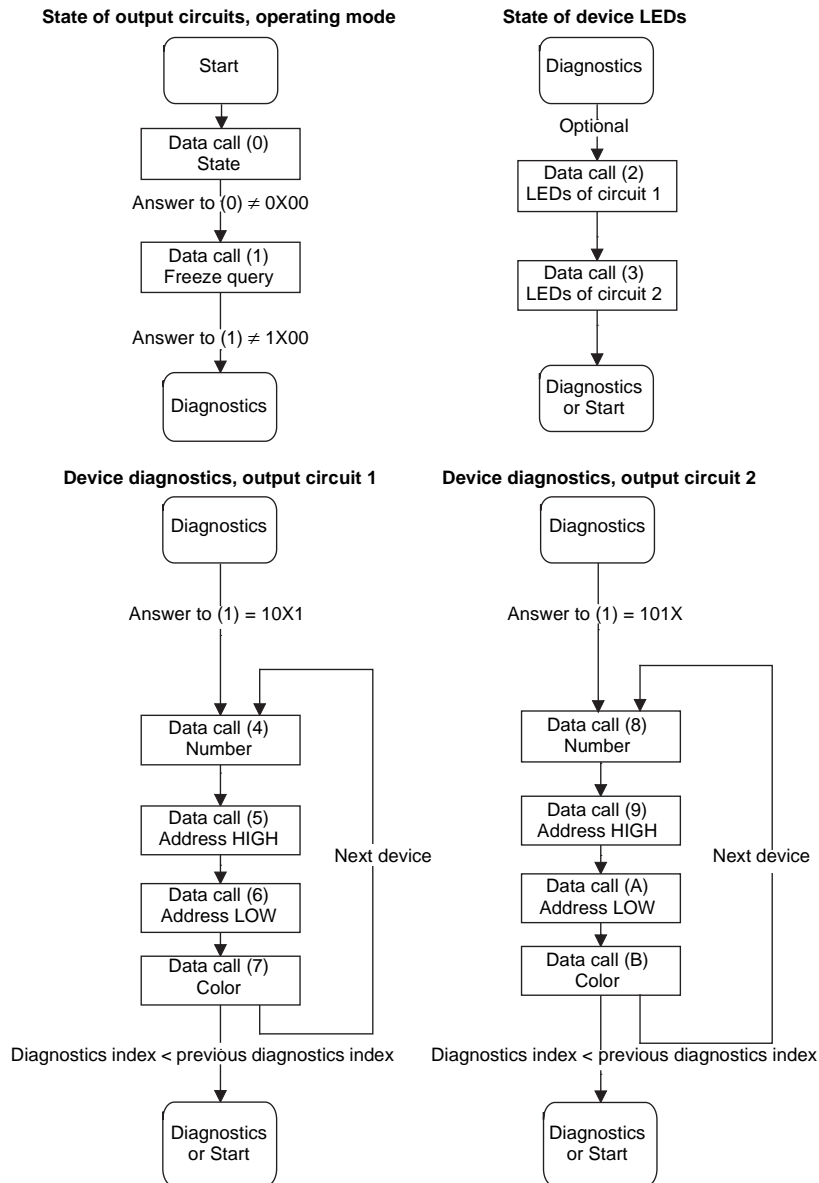


Figure 13.1: Querying with diagnostics sorted according to output circuit

## 14 EC Declaration of Conformity



the sensor people

EG-KONFORMITÄTS- ERKLÄRUNG (ORIGINAL)	EC DECLARATION OF CONFORMITY (ORIGINAL)	DECLARATION CE DE CONFORMITE (ORIGINAL)
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<b>AS-i Sicherheitsmonitor</b> Sicherheitsbauteil nach 2006/42/EG Anhang IV ASM1 / ASM1E / ASM2E Seriennummer siehe Typschild	<b>AS-i Safety monitor</b> safety component in acc. with 2006/42/EC annex IV ASM1 / ASM1E / ASM2E Serial no. see name plates	<b>AS-i moniteur de sécurité</b> Élément de sécurité selon 2006/42/CE annexe IV ASM1 / ASM1E / ASM2E N° série voir plaques signalétiques
Angewandte EG-Richtlinie(n):	Applied EC Directive(s):	Directive(s) CE appliquées:
2006/42/EG 2004/108/EG 2006/95/EG	2006/42/EC 2004/108/EC 2006/95/EG	2006/42/CE 2004/108/CE 2006/95/EG
Angewandte Normen:	Applied standards:	Normes appliquées:
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